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DWARF POINCIANA.  
CAESALPINIA PULCHERRIMA SW.  
( $\frac{1}{2}$  Nat. Size.)

# JOURNAL OF THE Bombay Natural History Society.

1946.

VOL. 46.

No. 1

SOME BEAUTIFUL INDIAN CLIMBERS AND SHRUBS.

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PART XXII.

[Continued from Vol. 45, No. 4. (1945), p. 461].

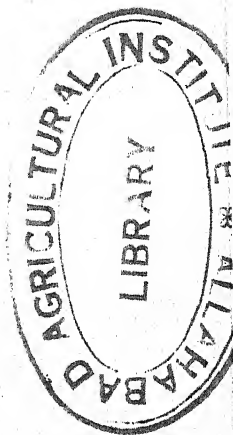
(With 1 coloured, 4 black and white plates and 7 text-figures).

## **Caesalpinia** Linn.

A genus of trees, shrubs and woody climbers belonging to the family *Caesalpiniaceae*. The name perpetuates the memory of Andreas Caesalpinus, 1519-1603, an Italian botanist.

The *Caesalpiniaceae*, at one time considered to be a section of the *Leguminosae*, but now accepted by most botanists as a distinct family, is a very well defined group of plants. Its flowers are intermediate between the regular flowers of *Mimosaceae* and the extremely irregular flowers of *Papilionaceae*. The fruit, however, is the characteristic and familiar pod of the sweet pea family.

The genus *Caesalpinia* is well represented in India and several of the indigenous species as well as some exotics are cultivated in Indian gardens on account of their showy flowers and handsome foliage. The family comprises trees, shrubs and woody prickly climbers. The leaves are large and abruptly bipinnate. The flowers which are usually yellow, sometimes red, are arranged





in large many-flowered racemes. The calyx consists of five segments which are imbricate in the bud. The petals are orbicular in shape with a distinct claw. Stamens ten in number, free. The ovary is sessile upon a disk and is usually few-ovuled. Pod various, sometimes covered with spines.

#### KEY TO THE SPECIES.

Stamens very long, much exceeding the petals.	
Stamens 3-5 in. long; sepals hairy on the margins, flowers yellow.	<i>C. Gilliesii.</i>
Stamens less than 3 in. long; sepals glabrous, flowers red, red and yellow or yellow.	<i>C. pulcherrima.</i>
Stamens not very long, hardly exceeding the petals.	
Pod prickly.	<i>C. Bonducello.</i>
Pod not prickly, dry.	
Pod flat.	
Large shrub or small tree.	<i>C. sappan.</i>
Climbing shrubs.	
Leaflets 2-3 pairs.	<i>C. nuga.</i>
Leaflets 8-12 pairs.	<i>C. sepiaria.</i>
Pod twisted.	
Climber; flowers in racemes.	<i>C. digyna.</i>
Large shrub or tree; flowers in dense panicle.	<i>C. coriaria.</i>

### **Caesalpinia Gilliesii** Wall.

#### Bird of Paradise.

(Called after Dr. Gillies who introduced to Kew? in 1929 from South America).

*Description.*—An erect shrub attaining a height of 6-7 feet.

Branches round, striate, covered with small, circular, raised lenticels, nearly glabrous but sometimes covered with short, crisped, white hairs. Leaves alternate, compound, up to 1 ft. long, stipulate, bipinnate; stipules at the base of the main rhachis, ovate-acuminate in shape, ciliate or laciniate on the margins. Leaves abruptly bipinnate; pinnae opposite or alternate, up to 1.5 in. long, without stipellae; rhachis of the pinnae slightly swollen at the base. Leaflets oblong, 1/6 in. long, rounded at both ends, shortly petioluled, rather thick, with a definite row of black glands inside each margin on both surfaces.

Flowers arranged in a terminal raceme, rhachis thick, woolly and covered with numerous red-stalked glands. Individual flowers pedicellate, each pedicel being supported by an ovate-acuminate deciduous bract which is hairy and glandular on the back and glandular-subulate-laciniate on the margins; pedicel of the open flowers .75 in. long. Calyx-tube short, turbinate, 1/6 in. long, glandular and hairy; calyx-lymb of five equal oblong segments covered on back and margins with flat-topped, shortly stalked glands, hairy outside, glabrous inside, about .5 in. long. Petals five, of a beautiful yellow colour, shortly clawed, seated on the margin of the calyx-tube 1.5 in. long, obcordate in shape. Stamens 10, free, arising from the top of the calyx-tube; filaments

4-5 in. long, crimson in colour, glabrous. Anthers oblong, versatile. Ovary seated at the bottom of the calyx-tube, shortly stipitate, hairy, prolonged into a long style with a capitate stigma. Fruit a falcate, leathery pod, beaked, 2.5 in. long.



Fig. 1.—*Caesalpinia Gilliesii* Wall.  $\times \frac{1}{2}$

*Flowers*.—Hot and rainy season. *Fruits*.—July-August.

*Distribution*.—Native of Mendoza, South America, now frequently cultivated in all tropical and subtropical parts of the world.

*Gardening*.—A very hardy shrub reaching up to 7 ft. in Dehra, with graceful feathery, bipinnate foliage of small leaflets. It flowers profusely during the hot and rainy seasons, the flowers being of a pale-yellow colour, the petals seldom fully expanding but the long stamens which are crimson in colour protrude. After two seasons or so the plant is apt to decay and look unsightly; it is consequently advisable to replace it by fresh seed. In Dehra Dun and elsewhere in this country the pods are frequently attacked by a borer which destroys the seeds. They should, therefore, be covered with muslin to protect them from

the ravages of these insects. Easily raised from seed sown during the rains or even earlier. According to Sir W. J. Hooker it was introduced by Dr. Gillies into the Royal Botanic Gardens, Kew, in 1829. It is popularly known as Dr. Gillies *Poinciana*, as Hooker, when the plant was first discovered, described it as *Poinciana Gilliesii*. It is a hardy plant and can be grown out of doors in England.

***Caesalpinia pulcherrima* Swartz.**

Dwarf *Poinciana*; Barbados Pride; Peacock flower.

(*Pulcherrima* means most beautiful in Latin).

*Description*.—A handsome shrub reaching 6 ft. in height. Branches smooth, green or glaucous, glabrous, shining, with a few prickles here and there. Leaves abruptly bipinnate, stipulate, up to 1·5 ft. long; pinnae 6-12 pairs, opposite, with small stipellae at the base, up to 3 in. long; leaflets oblong, 5 in. long, oblique at the base, emarginate at the apex with the midrib produced as a short mucro, very shortly stalked; each leaflet with a very small pair of stipels at the base of the stalk.

Flowers arranged in an erect terminal raceme. Flowers pedicelled; the pedicels of the fully opened flower being up to 4 in. long; pedicels supported at the base by a rapidly deciduous, lanceolate-acuminate bract, 1 in. long, which can be seen at the apex of the raceme surrounding the young flowers. Calyx-tube turbinate, 2 in. long, glabrous; limb 4-partite, one sepal larger than the others, hooded, glabrous, coloured red or orange in the bud. Petals about 75 in. long, distinctly clawed; limb orbicular in shape, often lobed on the margins, variously coloured in red and gold, very often claw and centre of limb crimson, red or golden-red, with a narrow margin of gold. Stamens 10, free, seated on the margin of the calyx-tube; filaments long, red, rather thick at the base where they are covered with white hairs, 2·25 in. long, tapering to the versatile anthers. Ovary seated on a short gynophore arising from the base of the calyx-tube, glabrous, compressed, terminating in a long yellowish red style. Pod nearly straight, narrow and thin, 2-3 in. long.

*Flowers*.—Hot and rainy seasons. *Fruits*.—Cold season.

*Distribution*.—Native country uncertain, perhaps South America. Extensively cultivated throughout the tropics.

*Gardening*.—A hardy, drought resistant, showy shrub up to 6 ft. or so in height. It flowers profusely during the hot and rainy season making the plant very ornamental. It should be cut in closely in the cold season, as it is apt to grow very straggly and becomes unsightly. It can hardly stand the cold of the Punjab but flourishes there and in the United Provinces better in the hot and rainy seasons than in Bengal. It is better to replace old plants every now and then by fresh plants raised from seed. This plant starts to flower as early as 8 months old. It is best suited for growing on lawns and for hedging. Easily raised from seed which it produces abundantly. According to

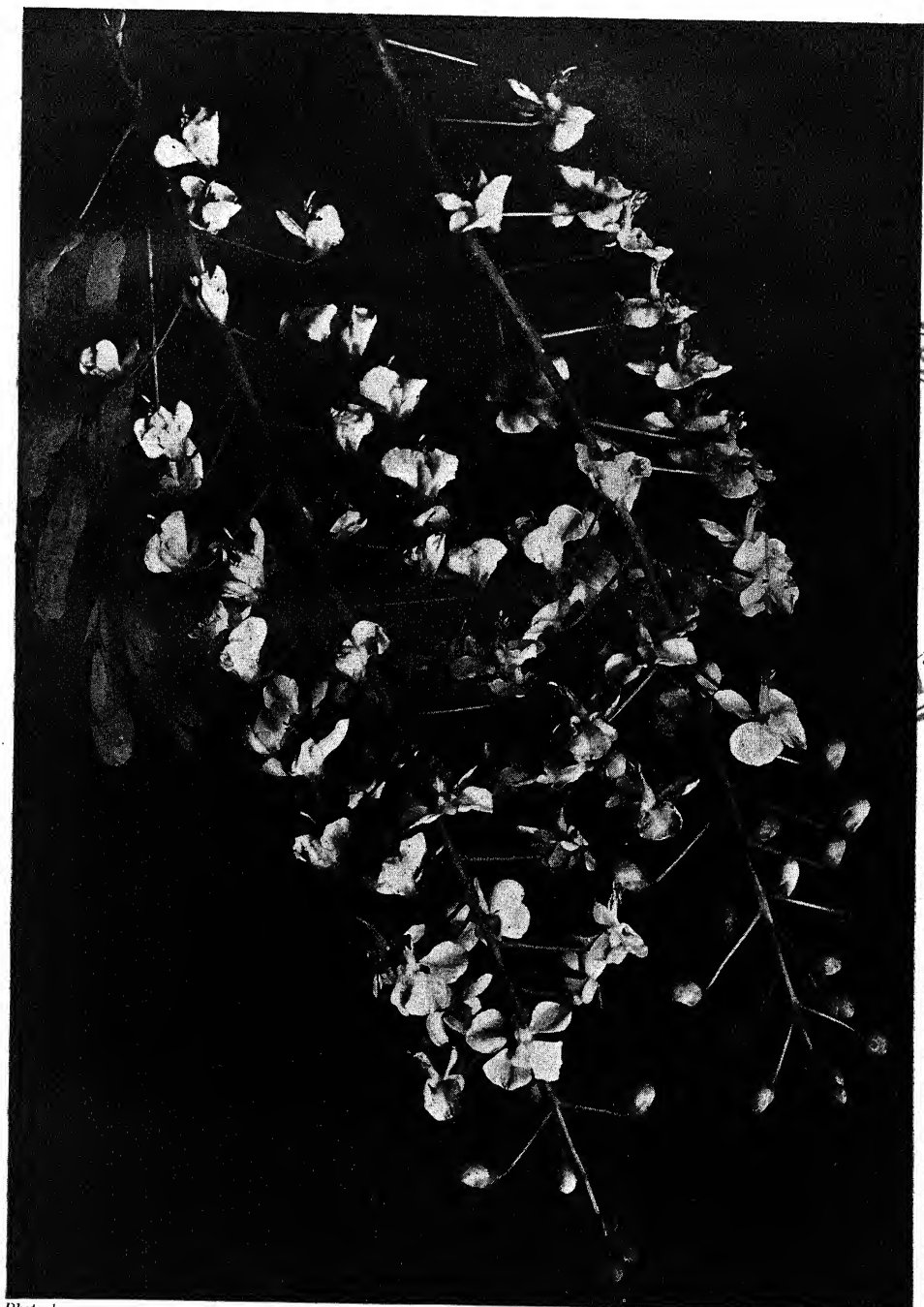


Photo by

M. N. BAKSHI

*Caesalpinia sepiaria* Roxb.  
New Forest, Dehra Dun.

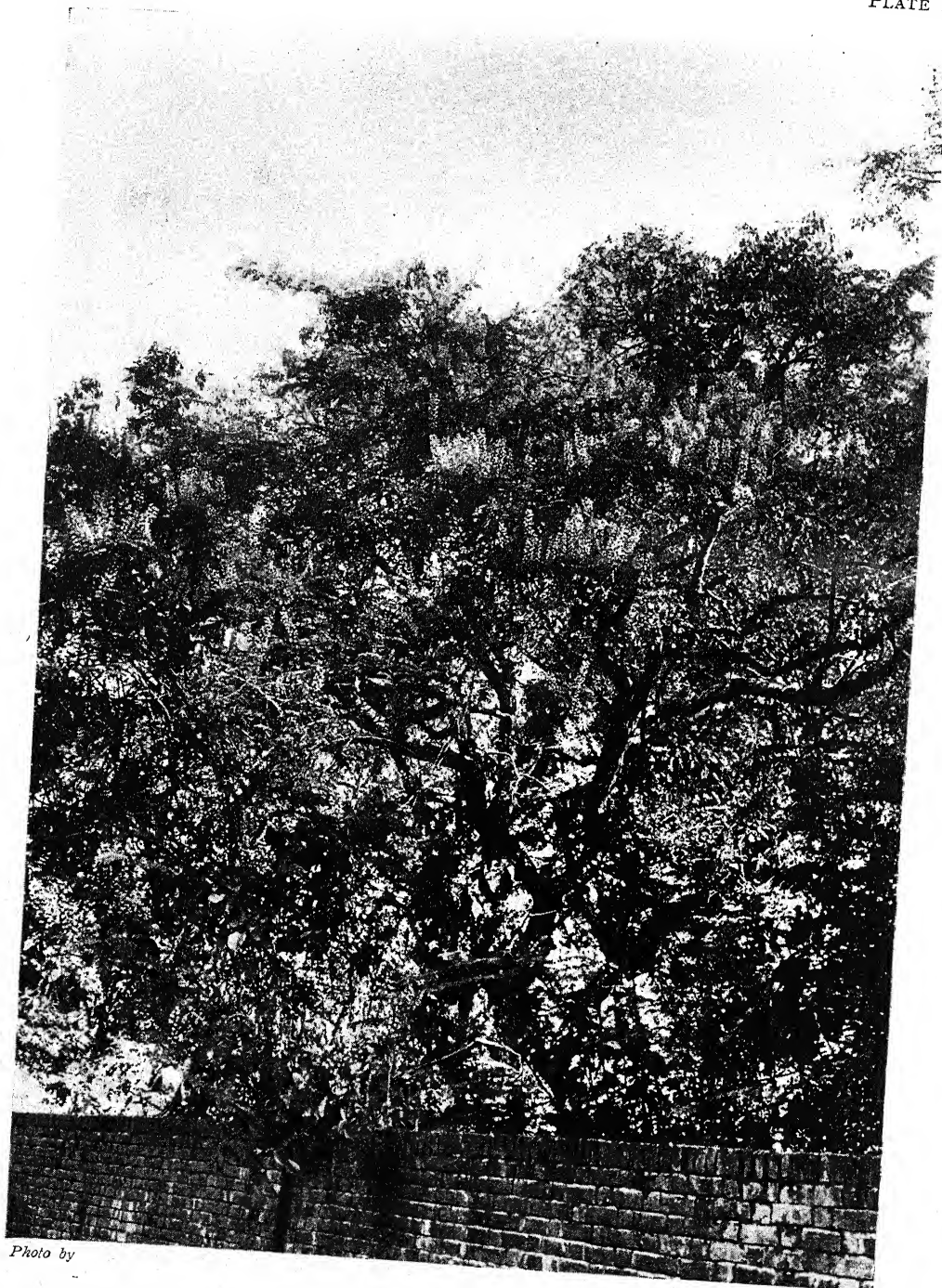


Photo by

*Caesalpinia sepiaria* Roxb.  
New Forest, Dehra Dun.

M. N. BAKSHI

Rheede, Hortus Malabaricus, it was in the gardens of India in 1680. It was introduced into Holland from Amboyna about the year 1670. On account of its showy flowers and attractive, finely divided foliage, this plant is a great favourite in all tropical and subtropical countries. Although this shrub will thrive in poor soil, an application of manure or chemical fertilizer may be given to advantage causing it to make more vigorous growth and give better and larger heads of flowers.

*C. pulcherrima* Sw. var. *flava* Hort. A race with bright yellow flowers, not nearly so handsome as the type. It is called 'Radha chura' in this country, the red race being named as 'Krishna chura'.

*Medicinal and economic uses.*—Burkill (Economic Products of the Malay Peninsula) remarks that this plant has a few medicinal uses in the Dutch Indies. The pounded roots are said to be useful in cases of infantile convulsions. The flowers are used as a remedy for intestinal worms, for coughs and chronic catarrh. The leaves are reputed to have a purgative action, and also to be abortifacient. A decoction of the leaves is said to be useful in cases of fever.

**Caesalpinia Bonducella** Fleming [*C. crista* Linn.].

Fever-Nut; Physic-Nut.



Fig. 2.—*Caesalpinia Bonducella* Fleming.  $\times \frac{1}{2}$

*Description*.—A prickly shrub, rambling or scandent. Branches more or less covered with short, soft hairs and armed with stout, sharp, straight or recurved prickles. Leaves compound 12-18 in. long, abruptly bipinnate, with the rhachis often produced as a short mucro; rhachis stout, covered with very short brown hairs and bearing sharp recurved prickles; pinnae up to 16 pairs, opposite; base of the rhachis of the pinnae with recurved stipellate spines. Stipules large, foliaceous, often lobed. Leaflets 6-10 pairs seated on very short pedicels with a pair of recurved prickles at the base, somewhat oblique at the base, oblong or elliptic, obtuse with the midrib produced as a short mucro, glabrous or sparsely hairy above, puberulous below.

Flowers arranged in axillary or terminal racemes, bracteate; bracts linear-lanceolate, tip subulate, 4-5 in. long, covered with rusty-brown hairs. Flowers pedicelled; pedicel 2-3 in. long, rusty tomentose. Calyx-tube very short; lobes 5, 2-3 in. long, rusty tomentose on both surfaces. Petals 5, golden yellow or the uppermost sometimes spotted with red, oblanceolate in shape. Stamens 10; filaments short, hardly exceeding the petals, covered with white hairs below. Ovary seated on a short gynophore which comes from the base of the calyx-tube. Pod broadly elliptic in shape, beaked, coriaceous, 2-3 in. long, covered all over with sharp wiry prickles.

*Flowers*.—August-September. *Fruits*.—Cold season.

*Distribution*.—Wild or naturalized throughout the tropics.

*Gardening*.—A scandent prickly shrub with yellow flowers which are produced during the rains. It is commonly met with in a wild state in abandoned village sites or in hedges. It makes an effective hedge-plant. Propagated easily from seed.

*Medicinal and economic uses*.—This plant, which bears the Sanskrit name of 'Pulikaranja', has long enjoyed a reputation for medicinal properties and was well known to Clusius and Rumphius. The leaves and seeds possess a substance known as bonducin of which the properties are not yet fully known. The substance is extremely bitter and appears to be absent from the roots. In India the seeds as well as the leaves are much used in native medicine to relieve colic, fever, hydrocele, diarrhoea and rheumatism.

### **Caesalpinia Sappan Linn.**

Sappan Wood.

(The specific name comes from its local name, *sepang*, in Java).

*Description*.—A thorny, shrubby tree reaching a height of about 20 ft. and a diameter of 6-10 in. Leaves up to 18 in. long, stipulate alternate, with 16-24 pinnae, each 4-6 in. long. Leaflets 20-36, chartaceous, oblong, very oblique at the base, almost sessile, rounded and slightly emarginate at the apex, glabrous above, puberulous below.

Flowers in paniced racemes, 12-16 in. long; separate racemes 4-6 in. long. Calyx-tube short, bowl-shaped; lobes 4 in. long, 5 in number. Petals 5, orbicular, 3 in. long, yellow; base of up-



per petal pink. Stamens 10 free, arising from the lip of the calyx-tube; filaments white, woolly in the lower half. Ovary stipitate, grey-velvety. Pod woody, oblong, flattened, 3-4 in. long, 1.5-2 in. wide, polished, brown, beaked.



Fig. 3.—*Caesalpinia Sappan* Linn.  $\times \frac{1}{2}$

*Flowers.*—Rainy season. *Fruits.*—Cold season.

*Distribution.*—From India throughout Malaysia.

*Gardening.*—A large thorny shrub quite ornamental when laden with its large panicles of yellow flowers. Easily propagated from seed which it produces abundantly.

*Medicinal and economic uses.*—The wood yields a beautiful red dye which is used to colour silk. The dye is also used for colouring starch which is scattered on the occasion of the Holi festival.

### ***Caesalpinia nuga* Ait.**

*Description.*—A, stiff, wiry, prickly climber with a blackish bark and few prickles. Leaves alternate with small stipules, bipinnate, 6-12 in. long, with 6-8 pinnae, often much less on flowering branches, rachis with recurved spines. Rhachis of the pinnae with recurved stipular spines at the base. Leaflets 2-3 pairs, light green above, rather pale below, coriaceous, ovate or elliptic, acute or obtuse, 1-2.5 in. long, .5 to 1 in. wide.



Inflorescence a panicle of racemes; racemes racemously arranged up to 6 in. long. Flowers fragrant, seated on pedicels,  $\frac{3}{4}$  in. long. Calyx broadly obconic, very short ( $\frac{1}{4}$  in. long), smooth, glabrous, 10-ribbed; limb consisting of 5 sepals, oblong, smooth and glabrous. Petals 5, yellow, clawed; limb orbicular crumpled; upper spotted with red; stamens ten, free; filaments hardly longer than the petals, dilated at the base and woolly below; anthers versatile. Ovary seated on an oblique gynophore, elliptic-compressed, sparsely hairy; style short. Pod turgid, beaked, indehiscent, 2 in. long.



Fig. 4.—*Caesalpinia nuga* Ait.  $\times \frac{1}{2}$

*Flowers*.—May-October. *Fruits*. Cold season.

*Distribution*.—Found from Bengal to the Pacific, chiefly along the coast, but also inland.

*Gardening*.—A vigorous prickly climber with yellow flowers which against the glossy green leaves appear quite ornamental. Readily propagated by seed which (as in all other species of this genus) should be well soaked in warm water for some hours before sowing.

*Medicinal and economic uses*.—The roots of this plant are stated to be diuretic by Watt. The same authority remarks that the roots as well as the roasted seeds are used externally as well as internally in diseases of the eye. In India the lac insect feeds on this plant.



Photo by

M. N. BARSHI

*Caesalpinia sappan* Linn.  
New Forest, Dehra Dun.

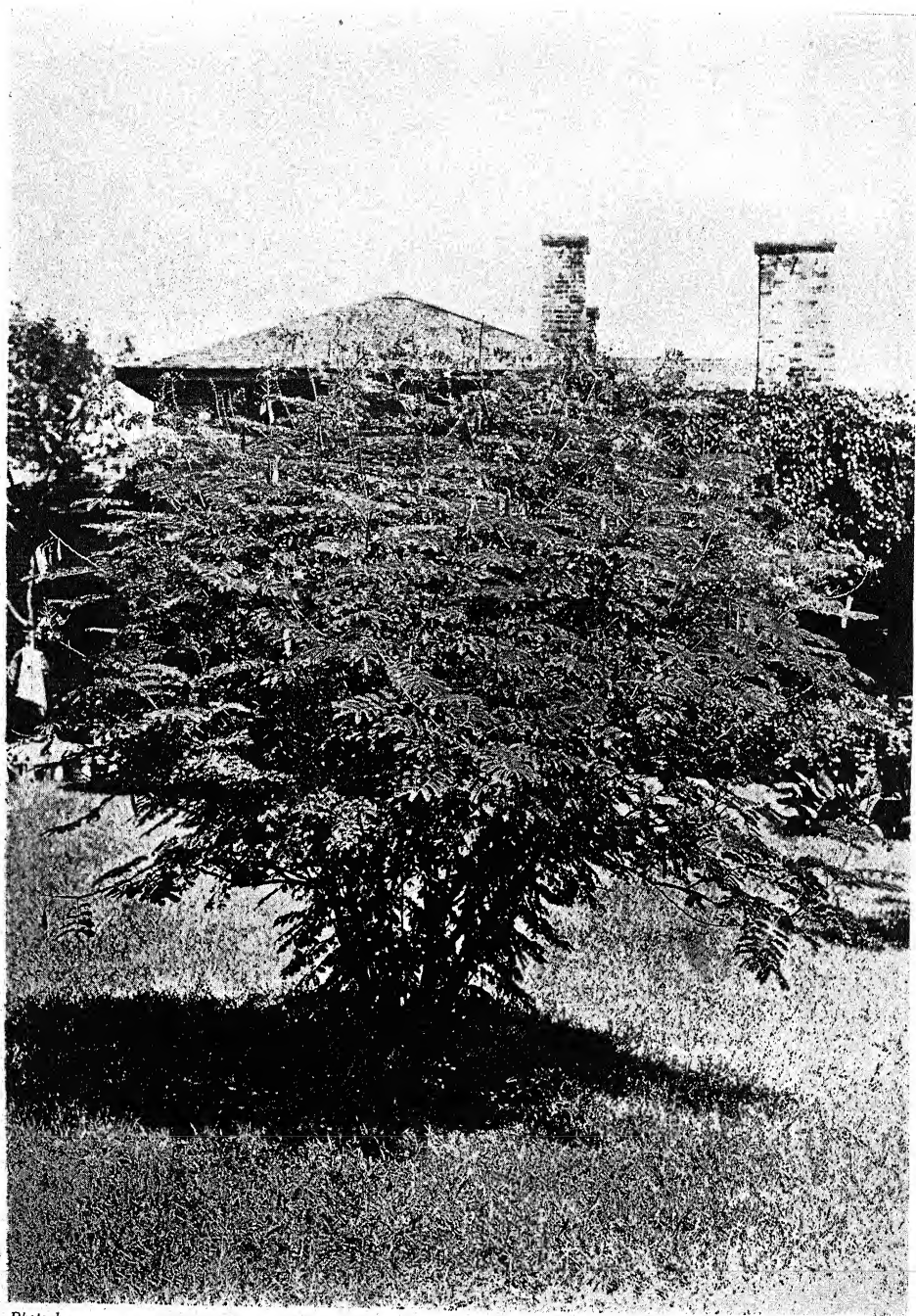


Photo by

*Caesalpinia pulcherrima* Sw.  
New Forest, Dehra Dun.

M. N. BAKSHI

**Caesalpinia sepiaria** Roxb.

The Mysore-thorn.

(*Sepiaria* is derived from the Latin verb *saepio*, to surround with a hedge, as this plant is often used as an impenetrable hedge).

*Description*.—A branchy scrambling or scandent shrub with dark red bark; branches glabrous or covered with dense rusty



Fig. 5.—*Caesalpinia sepiaria* Roxb.  $\times \frac{1}{2}$

or golden-brown pubescence. Prickles numerous, recurved, stout. Leaves compound, bipinnate, up to 1 ft. long, stipulate; stipules small, caducous. Pinnae opposite, stalked with a pair of recurved stipular thorns at the base, 6-10 pairs; leaflets rather thin, 8-12 pairs, shortly stalked, opposite, oblong, obtuse at both ends, emarginate at the apex, puberulous on the lower surface, green above, pale below.

Inflorescence a terminal, erect raceme, many-flowered. Individual flowers set obliquely on pedicels 1.25 in. long; pedicels ascending. Main rhachis of the raceme and pedicels fulvous hairy. Calyx-tube a broad inverted cone, fulvous hairy, 10-ribbed, .15 in.

long. Sepals 5, oblong, covered outside with golden hairs, glabrous inside, .3 in. long. Petals 5, obovate-obtuse, .5 in. long yellow, becoming reflexed as the flower opens fully to expose the bases of the filaments. Stamens 10, free, arising from the lip of the calyx tube. Filaments flattened at the base and distinctly woolly, .4 in. long; anthers versatile. Ovary seated on an oblique gynophore arising from the base of the calyx-tube, flattened-oblong, hairy. Style short. Pod beaked, 3-5 in. long, woody, glabrous, recurved, indehiscent, with the upper suture expanded into a narrow wing.

*Flowers.*—March-June. *Fruits.*—Rainy season.

*Distribution.*—Indigenous and naturalized throughout India and Burma (ascending to 5,000 ft. in Jaunsar), extending to Ceylon, the Malay Archipelago, China and Japan.

*Gardening.*—A large prickly climber. The large racemes of bright yellow flowers make a fine show. It makes an excellent hedge plant. Easily raised from seed.

*Medicinal and economic uses.*—This creeper, thanks to its prickly nature and very close mode of growth, is much used by Nagas as one of their village defences. The Nagas of Henima in days gone by, grew it very thickly around the village. The branches were erected on forked poles over the paths into the village during the day while at night the poles were removed and the creeper laid on the ground forming an impenetrable barrier to any marauder. This creeper may be seen to this day near the village entrance of most Angami villages.

The bark is said to be used for tanning in South India. It is also stated that the lac insect feeds on this species.

### ***Caesalpinia digyna* Rottl.**

*Description.*—A large, scandent, prickly shrub. Bark dark brown or dark red with plentiful, strong, recurved prickles. Leaves alternate, compound, bipinnate, stipulate, 6-12 in. long, with 8-12 pairs of pinnae: stipules lanceolate, small, caducous; rhachis sparsely hairy or glabrescent. Pinnae up to 2 in. long, shortly petioled at the base, with a pair of stipular thorns. Leaflets 7-10 pairs, .3 in. long, rounded at the top, slightly and obliquely cordate at the base, very shortly stalked; rhachis hairy.

Flowers yellow, arranged in terminal or supra-axillary racemes. Individual flowers numerous, seated on pedicels up to .8 in. long; bracts very small, caducous. Calyx-tube very short, almost salver-shaped, glabrescent with age; sepals five, oblong, hooded, rounded at the top, imbricate in the bud, the upper arching over the others and falling as the flower opens. Petals 5, inserted on the lip of the calyx-tube, orbicular, obovate or oblong, rounded at the apex, very shortly clawed, .25 in. long. Stamens 10, free, inserted on the lip of the calyx-tube; filaments dilated at the base and very woolly. Pod fleshy, shortly stipitate, 1.5-2.5 in. long, beaked, 1-2 seeded, twisted.

*Flowers*.—Rainy season. *Fruits*.—Cold season.

*Distribution*.—Found in India, extending to the Malay Peninsula and Ceylon.



Fig. 6.—*Caesalpinia digyna* Rottl.  $\times \frac{1}{2}$

*Gardening*.—A large woody prickly climber. It flowers abundantly during the rains, the petals being yellow streaked with red. Propagation is by seeds which are very hard and must be kept in hot water overnight or filed or injured in some other way before they will germinate.

*Medicinal and economic uses*.—The pods of this plant contain an excellent tanning material. The roots are said to be of use in phthisis and scrophulous affections.

### ***Caesalpinia coriaria* Willd.**

The Divi-divi plant; American Sumach.

(*Coriaria* is a Latin word derived from *corium*, a hide or skin, and refers to the use of the pods of this plant as a tanning material).

*Description*.—A large bush or sometimes a small tree with mimosa-like foliage on unarmed stems. Leaves compound, bipinnate; pinnae impari- or pari-pinnate, up to 6 in. long. Leaflets very numerous and narrow, .25 in. long, linear, green above, pale below, slightly obliquely-cordate at the base, emarginate at the apex, shortly stalked; main rhachis and rhachis of the pinnae hairy.



Flowers arranged in axillary and terminal dense panicles up to 2 in. long. Individual flowers on short pedicels, bud .2 in. long. Calyx-tube minute; lobes 5, oblong, rounded at the top,  $\frac{1}{6}$  in. long. Petals 5, inserted on the lip of the calyx-tube, spatulate, yellow. Stamens 10, free, arising from the lip of the calyx-tube, dilated at the base and hairy in the lower half; anthers versatile. Ovary stipitate, glabrous; style short. Pod twisted, thin, up to 3 in. long by .5 in. wide.



Fig. 7.—*Caesalpinia coriaria* Willd.  $\times \frac{1}{4}$

*Flowers*.—Sept.-Oct. *Fruits*.—Cold season.

*Distribution*.—Native of the West Indies and Central America, now grown in gardens in this country.

*Gardening*.—A spreading umbrella-shaped tree with dark green foliage and delightfully scented pale yellow flowers, suitable for planting in compounds. It is easily raised from seed, but is rather sensitive to frost.

*Medicinal and economic uses*.—The pods of this tree contain a powerful tanning material and it is much cultivated in South India.

(To be continued.)

# FIELD NOTES ON THE BIRDS OF COASTAL ARAKAN AND THE FOOTHILLS OF THE YOMAS.

BY

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These notes have been compiled during the Arakan campaigns of 1943 to 1945.

Subspecific names have not been added as we were unable to secure a series for comparison, owing to lack of suitable ammunition. Doubtful species, however, were shot for identification.

These notes deal with the sandy beaches, tidal waterways, mangrove swamps, scrub-covered islands, the villages and paddy-fields, and the foothills up to 2,000 ft. which rise from the coastal region often almost directly, and are covered with a variety of dense mixed tropical jungle, with scrub, or with pure bamboo jungle.

In the dry season, December to May, fresh water is very scarce and local, and practically all the hill streams are dry. In the monsoon, June to November, the rainfall is very heavy, averaging some 190 inches.

It is hoped that these notes may provide a foundation for a more critical study of the avifauna of Arakan at some future date, and may prove of value in the preparation of the second edition of the Birds of Burma.

ORDER: *PASSERES*.

FAMILY: *CORVIDAE*.

*Corvus macrorhynchos*. Jungle Crow.

Common.

*C. splendens*. House Crow.

Common about the village and tidal waters. Indian and Burmese races are found together in North Ramree Island. Akyab, Myebon, and Baronga Island. South of this area only the Burmese race is found.

*Cissa chinensis*. Green Magpie.

Foothills. One in May, blue being dominant colour. One in November in fresh green plumage in Ngakyedauk Pass.



**Dendrocitta vagabunda.** Indian Tree Pie.

Common in the low ground.

**Garrulus leucotis.** Burmese Jay.

Sparsely distributed in the jungles North and South of Ruywa.

FAMILY : TIMALIIDAE.

**Garrulax pectoralis.** Black-gorgetted Laughing Thrush.

Local in hill jungle, and even at sea level in winter.

**Pellorneum ruficeps.** Spotted Babbler.

Common in open lower jungle.

**Argya earlii.** Striated Babbler.

Old grassy rice furrows. Scarce.

**A. longirostris.** Slender-billed Babbler.

Fairly common in low ground.

**Timalia pileata.** Red-capped Babbler.

Local in foothills. Found nesting in June.

**Chrysomma sinensis.** Yellow-eyed Babbler.

Local in scrub jungle near the coast, and in patches of open country out of cultivation.

**Mixornis rubricapilla.** Yellow-breasted Babbler.

Common in the jungle.

**Pomatorhinus hypoleucus.** Arakan Scimitar Babbler.

Scarce. Foothills of Mayu Range in bamboo.

**Aegithina tiphia.** The Iora.

Common in open jungle and round camps.

**Chloropsis jerdoni.** Jerdon's Chloropsis.

Very uncommon. Low ground villages only in North Arakan.

**C. aurifrons.** Gold-fronted Chloropsis.

Common in foothills and round camps. This is the common Chloropsis of Arakan.

**C. cochinchinensis.** Burmese Chloropsis.

Uncommon. None seen North of Tamandu on Dalet Chaung.

FAMILY : PYCNONOTIDAE.

**Molpastes cafer.** Red-vented Bulbul.

Very common.

**Otocompsa jocosus.** Red-whiskered Bulbul.

Very common.

**O. flaviventris.** Black-crested Yellow Bulbul.

Common in the foothills.

***Iole virescens*.** Olive Bulbul.

Occurs in the thick Yoma jungle. Very secretive.

***Alcurus leucogrammicus*.** Striated Green Bulbul.

Apparently locally migrant as not observed in April-October. One 5 January. One 7 March.

***Microtarsus atriceps*.** Black-headed Bulbul.

Rare winter visitor.

***Microscelis psaroides*.** Black Bulbul.

Apparently a winter visitor from the higher hills. Latest 21 March.

***Criniger flaveolus*.** White-throated Bulbul.

Sparsely distributed along the coastal hill jungles, and in winter along the coastal belt. Seen in parties of up to 10.

FAMILY: TURDIDAE.

***Saxicola caprata*.** Pied Bushchat.

Common round the coastal villages.

***S. torquata*.** Stonechat.

Winter visitor to the coastal strip October-March.

***Enicurus immaculatus*.** Black-backed Forktail.

Common. The only Forktail seen.

***Calliope calliope*.** Rubythroat.

Winter visitor. Leaves in early March.

***Copsychus saularis*.** Magpie Robin.

Very common.

***Kittacincla malabarica*.** Shama.

Uncommon, but occurs as its song has been heard on one or two occasions, and one observed 25 October. Probably nesting in June and July.

***Monticola cinclorhyncha*.** Blue-headed Rock Thrush.

Sparse winter visitor. Earliest 24 September. Latest 24 April.

***M. solitaria*.** Eastern Blue Rock Thrush.

Earliest 1 October, latest 5 May. Common in winter.

***Miyophonus caeruleus*.** Whistling Thrush.

Winter visitor to the hill streams, being locally migrant as they dry up.

***Geokichla citrina*.** Orange-headed Ground Thrush.

One in a bamboo thicket 12 March. Another 10 February.

FAMILY: MUSCICAPIDAE.

***Muscicapa parva*.** Red-breasted Flycatcher.

Very common in winter. First arrival 30 September. Latest 30 April.

***Muscicapula rubeculoides*.** Blue-throated Flycatcher.

Common winter visitor to the foothills.

**Culicicapa ceylonensis.** Grey-headed Flycatcher.

Winter visitor in fair numbers to the thicker jungle from the higher hills.

**Alseonax latirostris.** Brown Flycatcher.

Sparsely distributed in the heavier jungle.

**Hemipus picatus.** Pied Shrike.

One 12 November, Mayu.

**Rhipidura aureola.** White-browed Fantail Flycatcher.

Sparsely distributed about village gardens.

**Hypothymis azurea.** Black-naped Flycatcher.

Sparsely distributed in the bamboo and thicker shadier jungles.

**Tchitra paradisi.** Paradise Flycatcher.

On winter passage from Duars. Chestnut phase of plumage usual, but one in white phase seen 10 November.

#### FAMILY: LANIIDAE.

**Lanius cristatus.** Brown Shrike.

Very common in winter. First arrivals 6 September. Latest 4 May.

**L. nepalensis.** Grey-backed Shrike.

Winter only.

**L. nasutus.** Black-headed Shrike.

One 31 October. One 15 November in foothills.

**L. colluroides.** Burmese Shrike.

Winter visitor from 3 October to foothills.

**Tephrodornis pondicerianus.** Wood-Shrike.

Sparsely distributed around villages. One 7 July. A pair 5 January.

#### FAMILY: CAMPEPHAGIDAE.

**Pterococotus roseus.** Rosy Minivet.

Several flocks seen and specimens secured in March and April.

**P. peregrinus.** Little Minivet.

A few flocks observed in the open jungles in October contained only males. Breeds in the Casuarina trees on the coast north of Akyab and at Teknaf. Also seen at Ruywa.

**P. speciosus.** Scarlet Minivet.

A pair on the Mayu Range 7 November. Resident.

**Lalage sykesi.** Black-headed Cuckoo-shrike.

Winter visitor in small numbers arriving about mid-October, leaving in April.

**Graucalus novaehollandiae.** Large Cuckoo-shrike.

Common among the wood oil trees in the lower jungles.

## FAMILY : ARTAMIDAE.

**Artamus fuscus.** Ashy Swallow-shrike.

Common.

## FAMILY : DICRURIDAE.

**Dicrurus macrocerus.** King Crow.

Common in the North. Scarce and local South of Maungdaw.

**D. leucophæus.** Ashy Drongo.

Pair 12 October. One 21 January. Sparse winter visitor.

**Chaptia aenea.** Bronzed Drongo.

Thick jungle. Very local, but usually to be seen in same area.

**Dissemurus paradiseus.** Large Racket-tailed Drongo.

Common in deciduous jungle.

**Bhringa remifer.** Lesser Racket-tailed Drongo.

Less common than the last named.

**Chibia hottentotta.** Hair-crested Drongo.

The most common of all the Drongos and well distributed.

## FAMILY : SYLVIDAE.

**Acrocephalus stentoreus.** Great Reed Warbler.

Local winter visitor to suitable reed-beds and clumps of pine-apple. In full song, 1 May at Akyab.

**A. agricola.** Paddyfield Warbler.

Rather scarce. Local winter visitor.

**A. dumetorum.** Blyth's Reed Warbler.

As above.

**Megalurus palustris.** Striated Marsh Warbler.

Common in the coastal belt from about 10 October to 15 April.

**Orthotomus sutorius.** Tailor Bird.

Common.

**Franklinia gracilis.** Franklin's Wren-warbler.

Common in scrub jungle.

**Prinia flaviventris.** Yellow-bellied Wren-warbler.

Common in coastal plain in winter.

**Cisticola juncidis.** The Streaked Fantail Warbler.

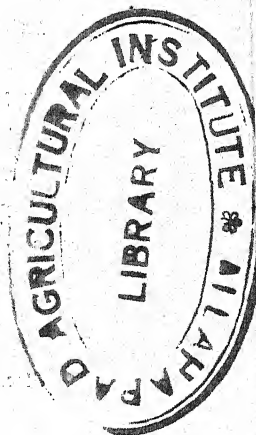
Fairly common in the coastal plain. Resident.

**Horeites brunnifrons.** Rufus-capped Bush Warbler.

Common winter visitor to scrub jungle.

**Phylloscopus fuscatus.** Dusky-willow-warbler.

Common in winter in the coastal swamps.



## FAMILY : IRENIDAE.

**Irena puella.** Fairy Bluebird.

Small parties of 5 or 6 seen on several occasions, in the tall trees in thick mixed jungle. Common in the Mayu Range.

## FAMILY : ORIOLIDAE.

**Oriolus xanthornus.** Black-headed Oriole.  
Common.

**O. chinensis.** Black-naped Oriole.

One 15 March. Pair nesting April in Yoma foothills. Uncommon and not seen in the coastal belt. One at Akyab 12 April.

## FAMILY : GRACULIDAE.

**Gracula religiosa.** Indian Grackle.

Fairly common where there are high trees in the open.

## FAMILY : STURNIDAE.

**Aplonis panayensis.** Glossy Stare.

Very local. Nests in old holes of woodpeckers in May. One found at sea-level and watched till young hatched.

**Sturnia malabarica.** Grey-headed Myna.  
Common.

**Acridotheres tristis.** Common Myna.  
Very common.

**Æthiopsar fuscus.** Jungle Myna.  
Very common.

**Sturnopastor contra.** Pied Myna.  
Very common.

**Gracupica burmanicus.** Jerdon's Myna.  
Flock of 20, 15 October in foothills.

## FAMILY : PLOCEIDAE.

**Ploceus infortunatus.** Eastern Weaver Bird.  
Common.

**P. manyar.** Striated Weaver Bird.  
Very local in reed-beds, but occurs in suitable localities and breeds.

**Lonchura punctulata.** Spotted Munia.  
Winter visitor in small flocks.

**L. striata.** Striated Munia.

Common in flocks in the foothills April-January and in late September. Absent in the monsoon and in winter.

**L. atricapilla.** Chestnut-bellied Munia.

Very common. Nest with eggs 22 November shows this species is not necessarily a pre-monsoon nester.

## FAMILY: FRINGILLIDAE.

**Passer domesticus.** House Sparrow.

Common around villages.

**P. flaveolus.** Pegu House Sparrow.

Very local. Observed on the islands off the coast at Ruywa in March, and one cock watched near Ruywa on the mainland.

**Emberiza aureola.** Yellow-breasted Bunting.

Singly and in flocks in winter and on passage.

## FAMILY: HIRUNDINIDAE.

**Riparia riparia.** Eastern Sand-Martin.

A few in winter only.

**R. paludicola.** Indian Sand-Martin.

Common.

**Hirundo rustica.** Eastern Swallow.

Very common in winter.

**H. tytleri.** Tytler's Swallow.

Common in winter.

**H. daurica.** Red-rumped Swallow.

Common in winter.

**H. smithii.** Wire-tailed Swallow.

Fairly common in winter.

## FAMILY: MOTACILLIDAE.

**Dendronanthus indicus.** Forest Wagtail.

Sparsely distributed in the thicker jungle.

**Motacilla alba.** White Wagtail.

Common in winter.

**M. cinerea.** Grey Wagtail.

Common in winter.

**M. flava thunbergi.** Grey-headed Yellow Wagtail.

A few on passage singly. All in April.

**M. flava beema.** Yellow Wagtail.

One 20 April. One 24 April. One 21 November.

**M. citreola.** Yellow-headed Wagtail.

One 14 May. Fairly common on passage, especially in April, and spends the winter.

**Anthus rufulus.** Indian Pipit.

Common and resident.

**A. hodgsoni.** Indian Tree-Pipit.

Common winter visitor.

**A. richardi.** Richard's Pipit.

Common winter visitor.

**A. cervinus.** Red-throated Pipit.

Winter visitor and passage migrant. Uncommon.

FAMILY : ALAUDIDAE.

**Alauda galgula.** Indian Skylark.

Rather scarce and locally migratory in the wet season.

**Mirafra assamica.** Bengal Bush-Lark.

Very common in the low ground.

FAMILY : ZOSTEROPIDAE.

**Zosterops palpebrosa.** White-eye.

Rather local; not common. Coastal plain and edge of foothills.

FAMILY : NECTARINIDAE.

**Ginnyris asiaticus.** Purple Sunbird.

Fairly common. Nests in March-April in coastal plain.

**C. zeylonicus.** Purple-rumped Sunbird.

Fairly common.

**C. flammaxillaris.** Yellow-breasted Sunbird.

Fairly common on the coastal plain south of Akyab.

**C. brasiliانا.** Van Hasselt's Sunbird.

Very local, but haunts same places. Smythies' description does not do this lovely bird justice.

**Æthopyga siparaja.** Yellow-backed Sunbird.

The most common Sunbird.

**Anthreptes malaccensis.** Brown-throated Sunbird.

Not common. Observed in Mar. near Myebon, and two other records.

**Arachnothera longirostra.** Little Spider-Hunter.

Common in the foothills.

FAMILY DICAÆIDAE.

**Dicaeum erythrorhynchos.** Tickell's Flower-pecker.

Not common. A few pairs seen in May in gardens.

**D. chrysorrheum.** Yellow-vented Flower-pecker.

Very local. Hill jungles. The race here appears to have dark streaks on breast and not the dark line described by Smythies.

**D. cruentatum.** Scarlet-backed Flower-pecker.

Common.

**D. trigonostigma.** Orange-bellied Flower-pecker.

Three pairs in March near Ruywa.

**D. concolor.** Plain-coloured Flower-pecker.

Common on the coastal islands from Myebon to Ruywa. Not seen elsewhere.

FAMILY: PITTIDAE.

**Pitta nipalensis.** Blue-naped Pitta.

Very shy though often heard. One obtained in Mayu Range in Oct. was definitely this species.

ORDER: PICI.

FAMILY: PICIDAE.

**Picus canus.** Black-naped Green Woodpecker.

Fairly common locally.

**Dryobates maharattensis.** Mahratta Woodpecker.

Fairly common.

**D. macel.** Fulvous-breasted Pied Woodpecker.

The race here has no white underparts. It is fairly common, especially at Akyab.

**D. analis.** Siamese Pied Woodpecker.

Lower hills. Scarce in Mayu Range.

**Brachypternus benghalensis.** Golden-backed Woodpecker.

Common.

**Chrysophlegma flavinucha.** Large Yellow-naped Woodpecker.

Lower hill jungles. No red on crown.

**Chrysocolaptes guttacristatus.** Tickell's Golden-backed Woodpecker.

Less common than the former.

**Mulleripicus pulverulentus.** Great Slaty Woodpecker.

Sparsely distributed in the jungle, but its distinctive cry is not uncommon.

**Sasia ochracea.** Rufous Piculet.

Common locally in the low ground.

**Jynx torquilla.** Wryneck.

One 27 Sep., one 25 Nov. Mayu Peninsula.

FAMILY: CAPITONIDAE.

**Cyanops viridis.** Lineated Barbet.

Common in the low ground.

**C. asiatica.** Blue-throated Barbet.

Common in the hills.



**C. duvaucelii.** Blue-eared Barbet.

Fairly common in hill jungle.

**Xantholaema haemacephala.** Coppersmith.

Very local and scarce except at Akyab.

#### ORDER : COCCYGES

##### FAMILY : CUCULIDAE.

**Cuculus micropterus.** Indian Cuckoo.

Common in winter. Earliest 7 Oct. Heard in April.

**Hierococcyx varius.** Common Hawk-Cuckoo.

Less common in winter. Heard in April.

**Cacomantis merulinus.** Plaintive Cuckoo.

Sparsely resident. All had lower parts russet, white.

**Clamator jacobinus.** Pied Crested Cuckoo.

One 25 May 1944.

**C. coromandus.** Red-winged Crested Cuckoo.

Fairly common in winter.

**Eudynamis scolopaceus.** Koel.

Scarce and local.

**Rhopodytes tristis.** Large Green-billed Malkoha.

Fairly common.

**Centropus sinensis.** Crow Pheasant.

Common.

#### ORDER : PSITTACI.

##### FAMILY : PSITTACIDAE.

**Psittacula eupatria.** Large Parakeet.

Scarce and local.

**P. krameri.** Green Parakeet.

Very common.

**P. cyanocephala.** Blossom-headed Parakeet.

Generally scarce and locally migratory, but very common in Mar. and Apr. at Ruywa.

**P. fasciatus.** Orange-breasted Parakeet.

The most common after the Green Parakeet.

**Loriculus vernalis.** Loriquet.

Common.

#### ORDER : ANISODACTYLI.

##### FAMILY : CORACIADAE.

**Coracias benghalensis.** Roller.

One in thick jungle Oct.

**Eurystomus orientalis.** Broad-billed Roller.

Common in open woodland.

FAMILY: MEROPIDAE.

**Merops orientalis.** Green Bee-eater.

Very common.

**M. superciliosus.** Blue-tailed Bee-eater.

Breeds in May and June. Locally migratory. Family party in Oct. in Kalapanzin Valley. Very common at Akyab in April.

**M. leschenaulti.** Chestnut-headed Bee-eater.

Resident but locally migratory.

**Melittophagus erythrocephalus.** Bronze-capped Bee-eater.

Appears to be a winter visitor.

**Bucia athertoni.** Blue-bearded Bee-eater.

Scarce. Nests in May. Resident and found nesting on summit of Mayu Range at 1,850 ft. in Oct.

FAMILY: ALCEDINIDAE.

**Ceryle rudis.** Pied Kingfisher.

Fairly common on the tidal chaungs and estuaries.

**Alcedo atthis.** Common Kingfisher.

Very common.

**Ramphalcyon capensis.** Stork-billed Kingfisher.

Scarce and confined to flooded rice fields and inland pools.

**R. amauroptera.** Brown-winged Kingfisher.

Locally distributed in tidal chaungs and swamps Not north of Dalet Chaung, and never noted at fresh water.

**Halcyon smyrnensis.** White-breasted Kingfisher.

Very common.

**H. chloris.** White-collared Kingfisher.

Common in tidal chaungs.

**H. pileata.** Black-capped Kingfisher.

Common in tidal chaungs.

FAMILY: BUCEROTIDAE.

**Dichoceros bicornis.** Great Hornbill.

Fairly common.

**Anthracoceros coronatus.** Pied Hornbill.

Rather rare.

FAMILY: UPUPIDAE.

**Upupa epops.** Indian Hoopoe.

Fairly common on passage and in winter. Absent in the monsoon.

## ORDER: MACROCHIRES.

## FAMILY: MICROPODIDAE.

**Micropus affinis.** Indian Swift.

Fairly common in winter.

**Cypsiurus parvus batassiensis.** Eastern Palm Swift.

Fairly common in winter.

**Chaetura gigantea.** Brown-throated Spinetail.

Flocks in thick jungle on Mayu Range.

## FAMILY: CAPRIMULGIDAE.

**Caprimulgus asiaticus.** Indian Nightjar.

Uncommon. I have only heard it in April and early May when it utters a 'Tuk-tuk-tuk-tuk-chirrh!'

**C. macrurus.** Horsfield's Nightjar.

Its monotonous 'Chunk-chunk' is a very common sound Mar-May. Resident.

**Lyncornis macrotis.** Great-eared Nightjar.

One pair observed at dusk for several evenings in Mar. at Ruywa, looking rather like harriers, and uttering a call on the wing like 'Pee-wheooo-wheooo-wheooo' repeated a variable number of times, followed by a protracted quavering whistle ending in a cadence. This was varied by a repetition of 'Hee-ho-hee-ho-hee-ho,' the 'ho' being a semitone lower than the 'hee.' Also heard at Myebon in Feb.

## ORDER: STRIGES.

## FAMILY: STRIGIDAE.

**Strix ocellatum.** Mottled Wood Owl.

Common.

**Bubo ketupa.** Brown Fish Owl.

Sparsely distributed, but not uncommon.

**B. coromandus.** Dusky Eagle Owl.

Often heard and seen sitting on the tracks at night.

**Otus sunia.** Burmese Scops Owl.

'Tonk tonk ka-tonk' is the commonest owl sound in Arakan.

**O. bakkamoena.** Collared Scops Owl.

Appears scarce and local. Nests in Apr. Utters a dismal 'whooh' at intervals.

**O. spilocephalus.** Eastern Spotted Scops Owl.

Fairly common. Utters a double whistle which is usually answered after an interval.

**Athene brama.** Spotted Owlet.

Common in the low ground.

**Glaucidium radiatum.** Jungle Owlet.

Fairly common in the jungles and high open forest.

## ORDER: ACCIPITRES.

## FAMILY: PANDIONIDAE.

**Pandion haliaetus.** Osprey.

A straggler in small numbers singly, in winter, to River Nat. Earliest  
27 August.

## FAMILY: VULTURIDAE.

**Gyps indicus.** Long-billed Vulture.

Very common.

**Pseudogyps bengalensis.** White-backed Vulture.

Scarce and appears migratory. It is absent May to Oct.

**Sarcogyps calvus.** King Vulture.

Common.

## FAMILY: FALCONIDAE.

**Aquila clanga.** Greater Spotted Eagle.

Several observed in winter. Very tame and often allowed an approach to  
10-15 yds.

**Circus ferox.** Short-toed Eagle.

One obtained Myebon in Jan.

**Spliornis cheela.** Crested Serpent Eagle.

Common.

**Haliaeetus leucoryphus.** Pallas's Fishing Eagle.

Local and uncommon.

**H. leucogaster.** White-bellied Sea Eagle.

Common.

**Ichthyophaga ichthyaetus.** Large Grey-headed Fishing Eagle.

Occasionally seen in winter.

**Haliastur indus.** Brahminy Kite.

Common.

**Milvus migrans govinda.** Pariah Kite.

Common but very few remain in the monsoon.

**Elanus caeruleus.** Black-winged Kite.

Very tame. Hovers like a kestrel. Winter visitor to Akyab.

**Circus macrourus.** Pale Harrier.

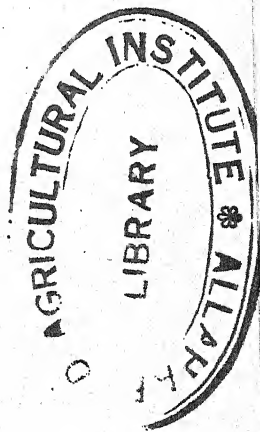
Common winter visitor. Arrives Nov.

**C. melanoleucus.** Pied Harrier.

Arrives 1 Oct. Fairly common in the coastal plain and islands.

**C. aeruginosus.** Marsh Harrier.

Common winter visitor.



**Astur badius.** Shikra.

Common.

**Falco peregrinus.** Peregrine Falcon.

Winter visitor in small numbers. Latest 4 Apr.

**Falco severus.** Hobby.

Winter straggler. Two observed.

**F. tinnunculus.** Kestrel.

Winter visitor in some numbers to Mayu Valley. Scarce elsewhere.

#### ORDER : COLUMBAE.

##### FAMILY : COLUMBIDAE.

**Crocopus phoenicopterus.** Common Green Pigeon.

Common in flocks.

**Treron pompadora.** Ashy-headed Green Pigeon.

Common in the Yomas. A few shot at Ruywa.

**T. bicalcata.** Orange-breasted Green Pigeon.

Common in flocks. The most common of all.

**T. curvirostra.** Thick-billed Green Pigeon.

Scarce.

**Ducula aenea.** Green Imperial Pigeon.

Usually seen in pairs. Fairly common.

**Chalcophaps indica.** Emerald Dove.

Common in the shadiest jungle.

**Columba livia.** Blue Rock Pigeon.

Rather scarce and local.

**Alsecomys puniceus.** Purple Woodpigeon.

One 17 Nov. and one 5 Dec. in thick tree jungle. Very shy.

**Streptopelia risoria.** Ring Dove.

Appears very scarce and local. Absent in the monsoon. One shot at Ruywa in Mar. A few seen at Maungdaw in Feb.

**S. orientalis.** Rufus Turtle Dove.

Scarce and local. A few shot at Akyab in Jan.

**S. chinensis.** Spotted Dove.

Very common.

**Oenopopelia tranquebarica.** Red Turtle Dove.

Common locally. Often in large flocks till May. Absent in the monsoon.

## ORDER : GALLINAE.

## FAMILY : PHASIANIDAE.

**Gallus gallus.** Red Jungle Fowl.

Common everywhere.

**Gennaeus horsfieldi.** Black-breasted Khalij.

Fairly common even at sea level.

**Arborophila rufogularis.** Arakan Hill Partridge.

A few were reported in the lower Yomas.

**Excalfactoria chinensis.** Blue-breasted Quail.

Common singly.

## ORDER : GRALLAE.

## FAMILY : RALLIDAE.

**Amaurornis akool.** Brown Crake.

Fairly common.

**A. fuscus.** Ruddy Crake.

Common.

**A. phoenicurus.** White-breasted Waterhen.

Common.

**Gallinula chloropus.** Waterhen.

Very local.

**Gallicrex cinerea.** Water Cock.

Scarce and very shy.

**Porphyrio poliocephalus.** Purple Coot.

Two or three at Royal Lake Akyab in winter.

## FAMILY : GRUIDAE.

**Grus grus.** Common Crane.

Two 4 Nov. Three 26 Mar.

## ORDER : LIMICOLAE.

## FAMILY : GLAREOLIDAE.

**Glareola pratincola.** Large Indian Pratincole.

Flock 27 Oct. Common and locally migrant. Breeds early among the dunes in Mar. and Apr. on Ramree and at Akyab.

## FAMILY : JACANIDAE.

**Metopidius indicus.** Bronze-winged Jacana.

Common in suitable spots.

**Hydrophasianus chirurgus.** Pheasant-tailed Jacana.

Very scarce and local.

## FAMILY: ROSTRATULIDAE.

**Rostratula benghalensis.** Painted Snipe.

Very local. Resident.

## FAMILY: BURHINIDAE.

**Burhinus oedicnemus.** Stone Curlew.

Ramree and Akyab in the dry west coast scrub. Rare and absent in the monsoon.

## FAMILY: CHARADRIIDAE.

**Arenaria interpres.** Turnstone.

Large flocks on the coast on passage. Winter visitor to Ramree.

**Squatarola squatarola.** Grey Plover.

Scarce winter visitor. A pair in breeding plumage at Ramree 30 Apr.

**Haematopus ostralegus.** Oystercatcher.

A few each winter Akyab, St. Martin's Island, Ramree.

**Charadrius alexandrinus.** Kentish Plover.

Scarce. One or two flocks which arrive in Nov. and leave in Mar. Latest 4 Apr.

**C. dubius.** Little Ringed Plover.

Common.

**C. mongolus.** Lesser Sand Plover.

Very common on the coast and on the mud flats in winter.

**C. leschenaultii.** Large Sand Plover.

Common winter visitor.

**Pluvialis dominica.** Golden Plover.

Very common winter visitor. Starts to arrive 25 Aug. Leaves in Apr. Latest 8 May.

**Hoplopterus duvaucellii.** Indian Spur-winged Plover.

An odd pair or single bird usually seen where there are sand banks on the river.

**Lobivanellus indicus.** Red-wattled Lapwing.

Common.

**Microsarcops cinereus.** Grey-headed Lapwing.

Small parties late Oct. Winter visitor till Apr.

**Numenius arquata.** Curlew.

Common winter visitor. Arrives Sep. Leaves as late as May.

**N. phaeopus.** Whimbrel.

Common. Arrives later than the last, and leaves earlier.

**Limosa limosa.** Black-tailed Godwit.

Several shot last week in Apr. feeding on paddy at Akyab.

**Terekia cinereus.** Terek Sandpiper.

Common. Flocks in Apr. on the coast. Most of those shot in Jan.-Apr. had drab legs, but some had orange.

**Tringa ochropus.** Green Sandpiper.

Common. An early winter arrival.

**T. stagnatilis.** Marsh Sandpiper.

Common winter visitor.

**T. hypoleucus.** Common Sandpiper.

Very common in winter. Only absent from May to Aug.

**T. glareola.** Wood Sandpiper.

Very common in winter, and numbers pass through up to early May.

**T. totanus.** Redshank.

Common. An early winter arrival in small flocks. Stays into May.

**T. erythropus.** Spotted Redshank.

One 15 January. One 12 March on the coast.

**T. nebularia.** Greenshank.

Common singly and in pairs. An early winter arrival.

**Erolia minuta.** Little Stint.

Common. A late winter arrival, not being seen before November. Leaves in late April and early May.

**E. temminckii.** Temminck's Stint.

One 15 November.

**Calidris tenuirostris.** Eastern Knot.

Scarce winter visitor to the coast.

**Scolopax rusticola.** Woodcock.

Three together on 16 March on Ramree.

**Capella gallinago.** Common Snipe.

Common winter visitor, but practically none are shot before 1 November or after 1 April. In October out of 54 shot 48 were *stenura* and only 6 *gallinago*. In November out of 51 shot 48 were *gallinago* and 3 *stenura*.

**C. stenura.** Pintail Snipe.

Very common. An early winter arrival, appearing in small numbers about 15 August and gradually increasing till November. Stragglers still seen 15 May.

## ORDER: GAVIAE.

## FAMILY: LARIDAE.

**Larus ichthyaetus.** Great Black-headed Gull.

Often an odd one about the River Naf in winter. 20 seen near Foul Point in January. Small parties seen near Ramree and Barongā Island from time to time.



**L. brunnelcephalus.** Brown-headed Gull.

Very common winter visitor but a late arrival. November to Many.

**Chlidonias hybrida.** Whiskered Tern.

A few on passage only.

**Gelochelidon nilotica.** Gull-billed Tern.

Common singly on the River Naf in winter only.

**Sterna aurantia.** Common River Tern.

Common, but absent September and October when presumably it is breeding.

**S. bergii.** Large Crested Tern.

Common. Breeds on St. Martin's Island.

**S. albifrons.** Little Tern.

One 10 April. One 6 December. Three 3 April.

#### ORDER: *STEGANOPODES.*

##### FAMILY: *PELECANIDAE.*

**Pelecanus roseus.** Spotted-billed Pelican.

Odd ones usually frequent the River Naf all the year round.

##### FAMILY *PHALACROCORACIDAE.*

**Phalacrocorax carbo.** Large Cormorant.

One shot 2 November. One 29 April. No others seen.

**P. niger.** Little Cormorant.

Common. Breeds in August and September.

**Anhinga melanogaster.** Indian Darter.

Very uncommon in spite of suitable localities.

#### ORDER: *HERODIONES.*

##### FAMILY: *IBIDIDAE.*

**Threskiornis melanocephalus.** White Ibis.

Common.

**Pseudibis papillosus.** Black Ibis.

Uncommon. I know of only one small nesting colony near Tumbru.

##### FAMILY: *PLATALEIDAE.*

**Platalea leucorodia.** Spoonbill.

Stragglers in winter only. One 5 January. One 21 Jan.

##### FAMILY: *CICONIDAE.*

**Dissoura episcopus.** White-necked Stork.

Common in small parties and singly.

**Xenorhynchus asiaticus.** Black-necked Stork.

Large flocks pass over going South in October. Stragglers remain in winter.

**Leptoptilos dubius.** Adjutant.

Scarce. Stragglers in winter.

**L. javanicus.** Lesser Adjutant.

Common in winter.

**Ibis leucocephalus.** Painted Stork.

Usually one or two about the River Naf and Kaladan delta in autumn and spring.

**Anastomus oscitans.** Open-bill Stork.

A flock of 40 going South 2 November over Maungdaw. Odd ones seen in winter.

FAMILY: ARDEIDAE.

**Ardea purpurea.** Purple Heron.

Common in the mangrove swamps in winter.

**A. cinerea.** Common Grey Heron.

Winter visitor arriving November.

**A. sumatrana.** Dusky Green Heron.

Fairly common in the creeks in mangrove swamps.

**Egretta alba.** Large Egret.

Common.

**E. intermedia.** Smaller Egret.

Scarce.

**E. garzetta.** Little Egret.

Very common.

**Bubulcus ibis.** Cattle Egret.

Rather scarce and local. Parties arrive about 1 October and winter, leaving in April.

**Demigretta asha.** Reef Heron.

Grey phase usual but one of white variety seen. Common on the Dalet Chaung.

**Ardeola grayi.** Paddy Bird.

Very common.

**Butorides striatus.** Little Green Heron.

Haunts jungle streams in the Yoma foothills.

**Nycticorax nycticorax.** Night Heron.

Fairly common. Party of 20 disturbed from trees during the landing at Myebon in January. Also seen at Ruywa.

**Ixobrychus sinensis.** Yellow Bittern.

Very local, but resident and nests in September in reed-beds near the coast.

**I. cinnamomeus.** Chestnut Bittern.

Common in the coastal plain.

**Dupetor flavicollis.** Black Bittern.

Common in the coastal plain.

## ORDER: ANSERES.

## FAMILY: ANATIDAE.

**Sarkidiornis melanotus.** Nukta.

Very local. One 12 December Nhila.

**Nettapus coromandelianus.** Cotton Teal.

Fairly common in suitable spots.

**Dendrocygna javanica.** Lesser Whistling Teal.

Common in flocks of up to 40 birds.

**D. fulva.** Larger Whistling Teal.

Scarce. Usually seen in pairs.

**Casarca ferruginea.** Ruddy Sheldrake.

Fairly common winter visitor. Does not arrive till end of November.

**Tadorna tadorna.** Sheldrake.

One flock of 7 going South 2 November.

**Anas penelope.** Wigeon.

An erratic passage migrant only. Not seen 1943-44 but huge flocks seen flying North over Dalet Chaung in first half February 1945.

**A. crecca.** Common Teal.

Common November to April. First arrivals 10 October.

**A. querquedula.** Garganey.

Rather scarce winter visitor with Common Teal.

**A. acuta.** Pintail.

Enormous flocks arrive in December and leave early March. They frequent inaccessible mangrove swamps by day, and feed in the shallow weedy fresh water pools at night. Stragglers arrive from mid-October.

**A. clypeata**.. Shoveller.

Winter visitor in small numbers.

**Nyroca nyroca.** White-eye.**N. baeri.** Bayer's Pochard.

A fair number pass through on passage in November and December, and again in February and March. Those shot had dark brown head with a greenish sheen (*baeri*), but I have reports of the typical race too.

## ORDER: PYGOPODES.

## FAMILY: PODICIPIDAE.

**Podiceps ruficollis.** Little Grebe.

Very common on the scanty fresh water pools along the coastal belt.

# CIRCUMVENTING THE MAHSEER AND OTHER SPORTING FISH IN INDIA AND BURMA.

BY

A. ST. J. MACDONALD.

(With 16 text-figures)

PART X.

(Continued from page 507 of volume 45).

Dont's and Do's about Rods (1). Fast Joints (2). Rods when out of use (3). Reels (4). Line Drier (5). Keeping swivels and split rings (6). Keeping large hooks (7). Killin wire (8). Gut (9). Wire for Mounts (10). Spoons made from old pots and pans (11). How to prepare atta or dough (12). Dressing lines with tallow (13). Dressing sea lines (14). Keeping dressed lines\* (15). Treating tacky lines (16). Rod and tackle varnish (17). Cobblers' wax (18). Steadying a boat. (19). Releasing hook hold in rapid water (20). How to weigh Giant Fish (21). Weighing fish with two or more scales (22). Calculating the weights of fish (23). Picking dead bait (24). Catching live bait (25). Determining the age of fish (26). Spikes for boots (27). Leeches and ticks (28). Maps (29). Rod cases (30). Clearing drinking water (31). Trophies of fish (32). Catching frogs for bait (33). Biting flies and how to evade them (34). Soldering Traces (35). Marking fish (36). Poaching (37). Butterflies (38). To soften butterfly's wings (39). Fish displaying temper (40). Record Mahseer (41). Thermometer (42). Photography (43). Formalin (44). Borax (45). Tackle Boxes (46) Fishing stools (47). Best Books on Fishing and Sport in India (48). Newman & Co. Calcutta (49). Sealing Wax (50). Enamel Paint (51). Packing and carriage of fish (52). Protecting flies from the ravages of insects (53). Dying Gut (54). Manufacture of Silk Worm gut (55). Knots for tying Gut, Flies, Hooks and Lines (56). Nylon for Casts (57). Garters (58). Ankle Puttees (59). Sore Toes and Feet (60). Sun Burn (61). Glare Glasses (62). Topee (63). Jacket (64). Tackle Outfit (65). To Skin and Preserve a Mahseer (66). Medical (67). Medicine (68). Wounds (69). Foul Hook (70). Bleeding (71). Blisters (72). Boils (73). Stings. Scorpion Stings (74). Septic Wounds from Tiger and Panther (75). Fever (76). Drowning (77). Addendum to Chapter 'Scraps from my note book' (78). Hardy's gut, wire, hooks etc.

1. *Don'ts and Do's about Rods.*—Don't put a rod away in a damp cover, or tops in damp cases. Don't use vaseline or oil on rod ferrules; tallow, raw mutton fat, or soap are the best lubricants. Don't tie rod cover tapes tightly when putting a rod away for any length of time. Don't hold the wood, or cane when putting a rod together; grip the metal ferrules in turning the rod joints or when pulling them apart.

Get your rod overhauled at the end of a season, or coat it over with varnish yourself; it will give you endless service if you do.

2. *Fast joints.*—If, as so often happens, ferrules get stuck a good tip in the first instance is to get two pieces of rubber (the inner tube of a car or motor cycle cut up does excellently), and wrap them around the joints, this will give you a good purchase, and will generally work the deed. Should this not prove successful, then heat the ferrule with a candle flame (BUT WELL AWAY

FROM THE LASHING), until it is too hot to touch, pour cold water over the joints when with the aid of the rubber it should come away. In case of an extremely tight joint a small pair of gas pliers will grip one socket without damage, and so enable the most obstinate of joints to be drawn apart.

3. *Rods when out of use.*—Hang up rods when not in use on a wall free from damp, and in a room that is in constant use, your dressing room for instance, so that they can be frequently looked over. Be careful to keep the plugs in, or a 'mason wasp' will plug it for you!

4. *Reels.*—Keep nuts and screws tight while in use, and look them over daily, or better still, after each run by a fish. One small screw lost, may put the whole reel out of action for the trip, unless you have spares. It is the hardest worked item of the outfit, and one which tackle makers have much to learn about and improve. Carry spare springs, ratchets and screws.

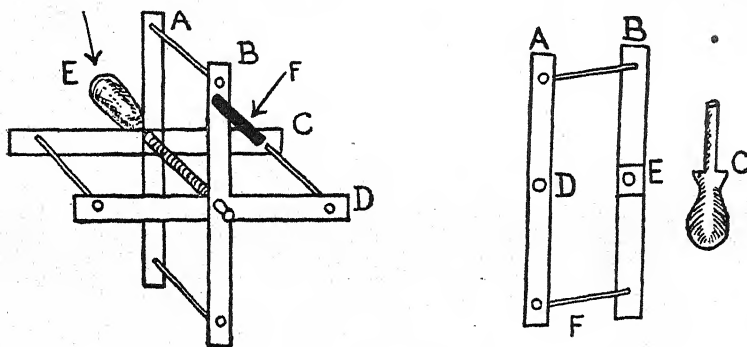


Fig. 1.—Line Drier.

5. *Line Drier.*—The four sides A. B. C. D. come apart, also the 4 stays connecting A. & B. and C. & D. When built up as in sketch, the handle and spindle E. is put through and keeps the frame together by a pin through the hole at top end of spindle, the handle is held in the left hand and the small handle F. on B. is the winding handle. Line can be cleared off a reel in a few moments. The size of the arm is 18 inches and width 6 inches. A. and B. are dove-tailed to take C. and D. inside at point of intersection. Many other forms are also offered by tackle dealers.

6. *Keeping swivels and split rings.*—I have found the best and most convenient way of keeping all small gear, like swivels, split rings, small hooks, etc., is by making use of small bottles and tins, putting them into these with oil. They keep for ever and save many a disappointment.

7. *Keeping large hooks.*—Hooks, and large or small trebles, keep best put into a tin with grease and the lid closed down. They are an expensive item and worth this additional trouble.

8. *Killin wire.*—Killin wire for traces, unless kept well oiled, will rust and many a spoon will be lost. This can be avoided by

wrapping a small strip of flannel dipped in oil around the reel of wire.

9. *Gut*.—Gut kept in flannel dipped in glycerine, will keep fresh, and will last for several seasons.

10. *Wire for Mounts*.—Cheap galvanised wire procurable in any bazar, or off a whisky case, makes excellent mounts for large spoons. (See chapter V, under 'Tackle').

11. *Spoons made from old pots and pans*.—Old cooking pots of copper, aluminium, or brass, make up into most useful spoons. These can be made up in any bazar at a quarter of the price one has to pay in tackle shops.

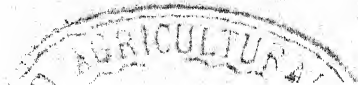
12. *How to prepare atta or dough*.—The best way to prepare atta, so that it sticks on one's hook in running water, is to have it first kneaded into a fairly thick mass, wrap a piece of fine cloth around it, then put into a pot and boil for a few moments, in this can be included any fancy smelly ingredients. Take out and knead until it is sticky and soft.

13. *Dressing lines with tallow*.—Plaited lines dipped in melted tallow make excellent spinning and casting lines. Coil the line into a convenient sized pot, with enough tallow to cover the line (a couple of tallow candles), when the tallow has melted, dip the line in for a couple of minutes, or until the tallow starts setting. Take the coil of line out, and with a flannel rag work a couple of yards at a time with the fingers, until it gets warm to the touch, move on to the next couple of yards and so on. This will give you excellent results, as it prevents the line swelling and does not rot the line. The more work you put in with the fingers the better is the result. Another good dressing, which also floats a line, consists of one ounce clean bees wax and one ounce (liquid measure) vegetable oil. Warm the bees wax and mix; treat line as for tallow dressing.

14. *Dressing sea lines*.—Stockholm Tar 2 ounces, methylated spirits 20 ounces, dissolve until well mixed. Coil line in a wide mouthed glass jar, pour in the mixture. Keep jar tightly closed for 48 to 60 hours. Then remove line and hang up to dry. Mixture will keep and can be used again. Sea lines, whether dressed in this way or not, should every day be washed in fresh water after use.

Synthetic resin glues, one of the discoveries of the War, form a bond of enduring strength, and is used in its different formulas to bond metal to metal or metal to wood or wood or metal to rubber, etc. It is as yet in its infancy so far as the household uses are known, but of its efficiency we may only look at the Mosquito, one of the best kites in the air today; all wood and bonded by this synthetic discovery. Here are some names to keep in mind, and watch out for their commercialization.

PHENOL-FORMALDEHYDE GLUE, Champion of all in waterproofing qualities, it is derived from phenol which is carbolic acid. It has stood six years of soaking at the Forest Products Laboratories in the U.S. and showed no more deterioration than the wood it joined. Once set no amount of heat can melt it. Other names to keep in mind are MELAMINE, UREA, RESORCINOL, and FURANE.



But the glue that is likely to prove the Angler's friend is PENACOLITE G 1131 and CASCOPHTEN RS 216. These are made by the Pennsylvania Coal Products Co., Petrolia, and Casein Co., of America, respectively. Both these phenolic-type resins set without heat, which is of the utmost importance as it permits of use without access to special equipment found only in factories. It brings its use within the scope of the layman and amateur craftsman. This glue is a liquid that will set at room temperature—from 75 degrees F. upwards after the correct catalyst is added. It is claimed to be far superior to cold-setting UREA resins that have been in wide usage for several years. Not only is it more waterproof but it requires less critical technique in handling. It remains immune to heat, humidity or wetting (a consideration in the varied Indian climate).

CYCLEWELD made by Chrysler Motors and PLIOBOND made by Goodyear Tyre and Rubber Co. are two of the better known compounds used for bonding rubber and wood or metal.

REANITE, METLBOND, and REDUX are other adhesives of that type. Synthetic resin glues are turned out as powders, liquids, emulsions, and films. Cold-setting resin powder of the UREA type is sold across the counter and available in hardware and paint stores. It is used by mixing with water.

Cold-setting phenolic liquid is expected to be offered to the general public in small packages shortly in America.

There must be the equivalent in as many makes in England or Britain but I have no details. Rod makers of repute will be closely interested, and quick to take advantage of this new discovery.

15. *Keeping dressed lines.*—An aluminium cigar-drier makes an excellent jar for keeping dressed lines, likely to get tacky, or in fact for any lines during the monsoon.

16. *Treating tacky lines.*—Most waterproof lines, so excellent in the English climate, get sticky and tacky out here, in a season. This can in most cases be cured in 'Lime Water' (sold by all chemists).

Put the lime water into a wide bowl or cooking pot, then put the tacky line in, coil by coil, so that it does not adhere, and prevent the liquid getting to parts on the surface. Allow it to soak in this over night (it does not damage the line), take the line out, remove as much liquid from the line, as you can, and hang out in a shady spot to dry. It is a good thing when dry to rub the line over with Ceroline or any animal fat. This should restore the line to its original texture.

17. *Rod and tackle varnish.*—Shellac and spirits of wine make an excellent varnish which dries soon after use. Shellac can be purchased in flake form in most bazars. Put flakes into a bottle and add spirits to give the required thickness. It melts in a couple of hours and no further treatment is necessary. Turpentine varnishes are also excellent, but take longer to dry. Cutex nail polish also makes a good varnish.

18. *Cobbler's wax.*—A mixture of equal parts of bees wax, lard and turpentine, make an excellent cobbler's wax.

19. *Steadying a boat.*—A good tip when only a light boat is obtainable, is to tie two or more large bamboos on either side along the whole length of the boat, they have a most steadying effect and prevent the boat rolling or taking in water while shooting a rapid. This is practised by the Shans and Kachins with good results in the upper waters of the Irrawaddy.

20. *Releasing hook hold in rapid water.*—The spoon is often caught up in snags and rocks in a rapid where a boat cannot go. A good dodge is to attach the line to a piece of bamboo or small forked branch by a running loop. Get above the spot where you are hung up, and release the bamboo, so that it will pass over where you are snagged. Give plenty of line, and as often as not, when the bamboo passes over or gets below where your hook is, fast, it will come away. An excellent tackle release—vouched for by a correspondent who has used it a great deal, is a three-quarter inch piece fairly hard wood four inches in diameter, with a bevelled hole through the centre, this hole big enough to allow largest sinker used to pass through. Outside edge of disc should be rounded and the wood be sand papered and painted white. The disc is slipped on the line by means of a V slit cut to centre hole and stopped by a smoothly and accurately fitting wedge. The disc on reaching the water works its way to where the bait is fast and the action of the water releases the hook. It 'works' in most cases, but not, of course, if the hook is in a 'snag'. Cost is nil, it is nearly always recovered as when a break away has to be made it floats and can be chased and collected by an attendant. It is worth its weight in gold as a saver of tackle.

21. *How to weigh giant fish.*—Cut two bamboos of equal length A. and B., fix them in the ground so that they give you a clearance of a foot at least, above the length of your fish. Slot these bamboos to take a third across C. Now mark off the centre of the bamboo C, and from here suspend your fish. With spring balance hook on one end, lift bamboo C and as soon as it moves take your reading.

This doubled will give you the weight of your fish. I have tested this method and found it works out exact with weighed fish. It would only be used on fish with greater weight than your scale registers.

22. *Weighing fish with two or more scales.*—The following is from the *Rod in India* and is produced here for information.

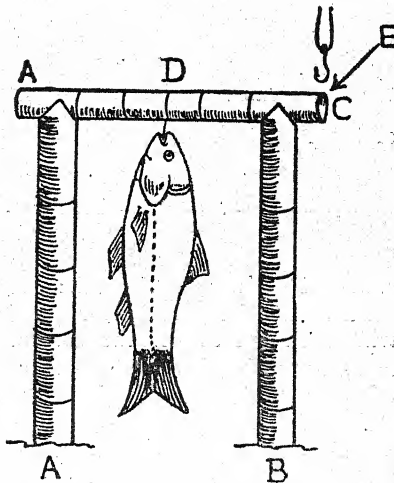


Fig. 2.—Weighing giant fish.



'When I bought my fishing tackle, I thought a spring balance weighing up to 32 lbs. was big enough for any man. But one fine day I had the misfortune to catch a mahseer well over that weight, and, of course I was particularly anxious to know its exact weight. I had in camp two spring balances weighing respectively up to 28 and 32 lbs. I passed a stout cord through the rings of the two, and suspended them from above. Then a cord attached to the fish and passed over the two hooks suspended the fish simultaneously from them both. Reading off the weight indicated by the two instruments and adding them together, the result was the weight of the fish, 46 lbs. If neither of the springs is pulled down beyond its power of springing, the total is bound to be accurate. I have tested it.'

23. *Calculating the weights of fish.*—By the common formula laid down in "The Angler's Hand Book", I have not found this work out consistently on the large fish. I have reproduced here four examples, in which only one is really anywhere near correct, still if no other means are available, it gives the approximate weight.

*Examples.*

$$\frac{\text{Length and one-third length} \times \text{Girth squared in inches}}{1000} = \text{weight of fish.}$$

Rivett Carnac's record mahseer of 119 lbs was 64 inches in length and 42 inches in girth. Example:—

$$\frac{(64 + 21) \times 42^2}{1000} = \frac{149940}{1000} = 149. \text{ 30 lbs. in excess.}$$

My three best fish, all healthy and game, work out as follows:—  
Weight 75 lbs. Length 50 inches, girth 34 inches, according to formula works out to 72 lbs. Three pounds short of actual.

Weight 50 lbs. Length 56½ inches, girth 28 inches, works out to 58 lbs. 8 pounds in excess of actual.

Weight 44 lbs. Length 52 inches, girth 26½ inches, works out to 48 lbs. 4 pounds in excess of actual. It is stated to me by a correspondent that such a formula is accurate to a pound if the measurement of length is to *fork* of the tail and one quarter and not one-third is taken e.g.  $\frac{L + \frac{1}{4} L \times G^2}{1000}$  is a good formula.

Brother Anglers may try it out for themselves.

24. *Pickling dead bait.*—Before inserting in the formalin solution, cut off the fins, all except the anal fin. When the fish begin to stiffen in the solution, the required sideways bend should be given to the tail: some to right: some to left. This bend cannot be given after the fish are stiff. Only actual practice will teach the angler the correct strength of formalin to use. If too strong the fish will be white; the weakest solution compatible with preservation will give the best results. The following two recipes for preserving minnows as spinning bait, are taken from the *Fishing Gazette*, with acknowledgements:—

1. 'Kill the minnows in a solution of formalin and water. In 24 hours or thereabouts, wash the minnow under the tap, in order to take as much of the smell of formalin out as possible, then place them in a wide-mouthed jar. Dissolve sugar and water and pour it over the minnows, leave the lot exposed to the air; in a week or so smell the minnows to see if the formalin taint has disappeared; sugar and water in which they are may be kept for months.'

2. Minnows preserved for use as spinning bait should be free from the smell of preservative. Salted specimens are good, but not so well suited to the purpose as those prepared by the following method. Formalin as sold to the public is acid and for our purpose should be non-acid. The necessary change can be effected by adding a pinch of baking powder to an oz. of formalin. Keep the minnows alive for 48 hours in a basin of water to which has been added a teaspoon of common salt; this will reduce the size of their bellies. Kill by a flick on head with finger nail and place in a bottle to be tightly closed (Prune jar excellent) in which is: distilled water 99 parts, non-acid formalin one part. After a few days change the solution. The fish will keep for a long period. When required for use remove any smell of formalin there may be, by washing in salt water; and if possible, to make quite certain, mix the prepared minnows with fresh ones and all smell will disappear. If the baits are large, they can have a bend given them to assist spinning. This bend they will retain.'

About a dessert spoon full of formalin to a pint of water is enough for small baits. The more formalin, the more difficult to get rid of the smell; so use it as weak as suffices to preserve the minnows in the first instance. The sugar solution should be weak, merely a thickish fluid, the formalin makes the minnows tough and if too strong, turns the eyes white, and takes the colour out of the fish. If the sugar solution is too strong, it is apt to shrivel the bait. The minnows are not ready to transfer to the sugar and water until they are firm to the feel, and rubbery to the touch. Sometimes a scum comes on to the top of the sugar solution, but this does not matter and is caused by not completely covering the fish with the solution. When required for use, a few fish can be taken out, washed, and carried in a tin box, surplus minnows being returned to the solution at the end of the day.

Several fish can be killed on the same minnow. The formalin solution should be 2 per cent or one part formalin to 49 parts water.

There are other ways too of pickling dead bait, but I think the latter of these two is the simplest and the most convenient as well as the best.

Taint of preservative of any kind will be removed from prepared baits by smearing them with Pilchard oil (doubtless Sardine oil equally effective)."

—*Fishing Gazette* 6-8-1921.

Another method of preserving fish, is to place the *chilwa* on a board with the tails curved by means of pins. These are then painted with a strong solution of formalin (3 teaspoons formalin to 2 tablespoons water). After ten minutes the baits are absolutely set, and are then placed in a jar containing two tablespoons of formalin per pint of water. In three days the baits become rubbery and hard. Once the baits have become saturated with formalin, they can be carried dry during a fishing trip.

25. *Catching live bait*.—In a running stream, if you are unable to catch small fish for bait, a useful tip is to dig a small channel a few inches across and a couple of inches deep, and connect it a few yards above into a small pool where fish can be seen. In this run put some atta, tied up in a cloth so that it runs down mixed with the water. This should be done at night. Early next morning, the channel should be closed at both ends; you will be unlucky if you are not provided with bait for that day. It is not always possible to dig a channel. If there is a fall, erect a small platform with cloth or fine net and arrange your atta in the same

way, so that it washes through to the pool below. The small fish will jump to get up to better feeding, and get caught on the platform. It should be erected low enough to catch jumping fish, but should not hold water, or they will jump out again. This method can also be applied from a boat, by erecting your trap over one side, and holding a lantern on the edge. Fish have a strong curiosity for lights. If no suitable small stream is near by, and there are only large pools, get a basket and cover it over with a fine cloth, lower the basket into the water until it is covered by about ten inches of water, in it should be put rice atta or any other suitable bait. Make a few holes in the cloth so that the bait can run out and fish go in. Fish find their way in and get trapped.

26. *Determining the age of fish.* (From the *Scientific American*):

'The age of a fish can be determined with accuracy by inspection of the otoliths or bony concretions, which are found in the auditory apparatus. The otoliths increase in size during the entire life of a fish, each year adding two layers, a light coloured one formed in summer and a dark one formed in autumn and winter. The alternate layers are sharply contrasted and very distinct, so there is no difficulty in counting them. The number of pairs of layers is equal to the number of years a fish has lived.'

27. *Spikes for boots.*—Whiteaway Laidlaw & Co., Calcutta, sell excellent screws for boots called 'Plus Four Screws'. Rowe & Co., Rangoon, also stock excellent studs sold with a punch and screwing device complete. A very handy and cheap addition to one's fishing kit.

28. *Leeches and ticks.*—Never pull off a tick or leech, one is seldom without matches and an attendant. Burn a leech with the flame of a match, by holding its body away and applying the flame, it will at once leave go. For a tick, too small to burn, heat a pin point and touch it with it. Here are one or two suggestions as a precautionary measure against these pests. When there is no wading to be done, a strong infusion of tobacco leaves with addition of salt is effective, and does equally well for master and his bare legged followers. Wear two pairs of stockings woollen below and a pair of cotton stockings soaked in the mixture above. The wearing of a high spat well damped in kerosine and worn over woollen and cotton stockings, as above, will keep off leeches, whether you wade in water or not. Kerosine must not get to the skin or blistering will result.

A sure preventative against tick bites is.—Cocoanut oil 90 parts, eucalyptus oil 10 parts. Anoint the whole body neck to toe, before dressing. Ticks may crawl, but they won't bite. (You can decide for yourself which is preferable tick bite or this oil bath!)

29. *Maps.*—Whenever undertaking a trip into unknown country, a large scale map of the locality is of great value. One is able to mark in good spots, letter runs and rapids, which serve with notes for any future trip. These are obtainable from the Government Map Depot, Wood Street, Calcutta, at a very nominal charge.

30. *Rod cases.*—A cheap and most serviceable rod case can be made up from the large hollow bamboos that are common in Burma and India. Cut a section from one of these, long enough to take

a rod leaving a knot intact at one end. From the other end, burn or cut out the knots, and have a leather cup fitted with strap and buckle. If this is not possible cut the length of bamboo in half,

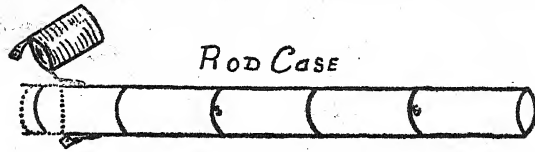


Fig. 3.—Rod Case.

cut out the knots and bind together again, with the same fitting as in the first case. See diagram.

31. *Clearing drinking water.*—If one is dependent on the river for drinking water, and it should come down in spate, a pinch of alum put into a bucket of discoloured water will soon clear it. It is a handy commodity to have by one, being an excellent preservative for skins. Or you can dig a hole some feet away from water's edge and obtain reasonably filtered water.

All drinking water should be boiled: but on occasions when this is not possible one drop of tincture of iodine of seven per cent strength to a quart of water: and the water then well shaken: will, in 20 or 30 minutes, kill all the harmful bacteria that are likely to be there. The amount of iodine added is too slight to even taste.

32. *Trophies of fish.*—The gill plates and teeth of large mahseer make good souvenirs. They can be made up into a quaint mascot for a car, or mounted on a shield. Scales make useful luggage tickets, and menu cards, but are a temptation to the souvenir hunter.

33. *Catching frogs for bait.*—Frogs are curious little creatures and if one dangles a piece of rag tied on a hook above them they will surely jump to catch it, in this way you can fill a pot, should you want them for bait. Most predatory fish relish frogs. The green and yellow, or brown, are the best. Do not confuse frogs with toads.

34. *Biting flies and how to evade them.*—Citronella or Flit, keeps off the many varieties of biting flies met with in the densely forested areas, particularly in Burma and Assam. Smears over the knees, hands, and neck prevents much discomfort and misery. These liquids are evanescent. Citronella mixed into white vaseline (as done by the Forest Dept.) forms an unguent which has lasting effect.

35. *Soldering Traces.*—'Tinol' is an excellent soldering paste for securing the ends of wire. A little applied to the end of wire and passed through a lighted match sets it firmly, causing no damage to the wire. The 'Britinol soldering outfit' or one of similar efficiency, is essential to an Angler.

36. *Marking fish.*—This is unfortunately little practised out here, because of the size of rivers and a shifting community. Where ever it is possible, as in the case of fishing clubs, marking of fish should be introduced, as it gives most interesting results. A

simple method is with a small brass or copper foil plate,  $1\frac{1}{2}$  inches long by  $\frac{1}{2}$  an inch wide fixed to the dorsal fin by thin copper wire with distinguishing letters, and a note made in the fishing book at the club or fishing hut. (See diagram.)



Fig. 4.—Method of marking fish.

most original clucking noise. Frequently the cock would come to investigate, when he would shoot it. He kept me provided in this way, though most of them were tough patriarchs. In Ceylon, jungle cock are enticed in a similar way by a handkerchief loosely held and brought together by the hands to make a 'clapping' sound, taken by the cock to be the challenge of a rival.

38. *Butterflies*.—A small net for catching butterflies, is a handy and useful addition on a fishing trip. On the odd day when the river is coloured and fishing not possible, a few hours can be well spent gathering a variety of butterflies. Small paper packets for preserving specimens can be made up from greaseproof paper; and even though not up in the scientific names, you will find lots of people who will be pleased to take your collection. Burma has some beautiful specimens, which if set and arranged in a case make a useful ornament in the home.

39. *To soften butterflies' wings*.—Take a tin of convenient size one inch deep, and fill it with saw-dust, then place a sheet of damp blotting paper soaked in a solution of water, with a few drops of Carbolic acid, this is added to prevent moulds which otherwise grow quickly. Put the dry insects into the tin and keep for six hours, or until the wings are moist enough for setting.

40. *Fish displaying temper*.—I saw a fish display what one would reasonably describe as temper. This was in a stream, in Burma, a few yards from my bungalow. I had some 200 mahseer collected from 4 pounds down to a few ounces, where I used to feed them daily under a large concrete bridge. They were protected and no fishing allowed. The stream was no more than 6 yards across and 4 or 5 feet deep and crystal clear. They made an interesting study. It was here that I saw a fish of  $2\frac{1}{2}$  pounds clear the hole of some 60 or 70 large fish. The trouble arose when I put in a short hand line with a fly spoon to catch a fish or two for purposes of marking. This fish broke my line and the small Mother-o-Pearl spoon could be seen distinctly hanging from the fish's mouth. Any fish that came near it was chased. The whole performance was clearly visible and most amusing.

41. *Record Mahseer*.—From *The Field* dated 11-1-1920, by Mr. Van Ingen:—

37. *Poaching*.—The Burman is an adept at poaching. The cleverest thing I witnessed in this line was by my servant. If a jungle fowl called, he would go into the forest as near as possible to the cock, sit concealed in a bush, and utter noises like a hen scratching and feeding, he accompanied this with a

'Whilst fishing on the Cauvery last Christmas, with Mr. P. F. Bowring, D.C., Mysore, Col. J. S. Rivett Carnac and Major C. Jackson, V.C., I had the pleasure of witnessing the capture of the largest mahseer ever caught on rod and line in India. This mighty fish was caught by Col. Rivett Carnac on December 28th, 1919, and was of the following measurements, weight 119 pounds; length 64 inches; girth 42 inches; tail fin 20½ inches; circumference of mouth 26 inches. Previous to this, the record mahseer caught in India, was 104 pounds, caught in 1906 by the late Mr. C. E. Murray Aynesley, at the junction of the Huddy and Cauvery rivers in Coorg, and the largest fish (other than the mahseer was a 112 lbs. Goonch). I feel sure that many years will elapse before the Colonel's record is beaten.'

'This 119-pounder on being hooked, put up a tremendous fight, running out about 125 yards of line in her first rush (so characteristic of the mahseer), and had she kept on straight a break was inevitable, hardly 5 yards of line remaining on the reel, but fortunately for the fisherman she turned and made up stream, and the Colonel was able to recover line. After that the fish made several other big rushes, but there was line to spare. I was keeping time, and it was 25 minutes before we got a glimpse of her, and finally, when she was gaffed by Mr. Bowring and drawn ashore, the excitement was so great that I quite forgot the timing. The average for 1,600 lbs. of mahseer caught this season, works out at about 4 lbs. a minute, so the 119-pounder must have taken half an hour or more. This old hen-fish had a huge hog back, and her body almost cylindrical in shape and must have seen many monsoon floods; and, judging from the age of sacred fish in Mysore, she must have been 200 years old. Major Jackson hooked a fish immediately after this big one was landed, and in almost the same place, probably her sister. This fish ran out about 160 yards of line, and after two hours' hard work got round a snag and broke. The scale used for weighing this mahseer registered only up to 112 lbs, and we were obliged to cut the fish in two pieces and weigh both pieces separately; consequently some blood was lost in this operation, and the fish had been in the sun and wind for three hours before weighing. Yet with all this, the actual weights registered, totalled 119 lbs. I am sure had we suitable scales, the fish immediately after capture would have been 120 lbs.'

In contrast to Mr. Van Ingen's account, I reproduce Mr. Lacey's fight with a 61-pounder at Tangrot, from *The Angler's Hand Book*:—

'This last fish the biggest on record in the Tangrot Angler's book up to the present, was hooked about 9-30 A.M. He rushed all my line out, 140 yards, just as I landed from my boat, and was pulling dead on the knot.\* I ran on, but fell in the mud, when my boatman Rokundin, to whom great praise is due, seized up the rod, and rushed into the water, the fish now making straight across the water for the "big rapid". Most fortunately Deputy Surgeon-General Cellis' boat was following mine, and getting into it, we followed the fish down the rapid, at a frightful pace and at one-time must, I believe, have passed the fish, the 140 yards of line being loose in the river, but providentially it caught in no rock, and I found the fish on when I landed below. Two or three times he had taken all the line out, and was pulling dead on the knot; but by a miracle nothing broke. The fish took to sulking, and for fully 3½ or 4 hours, I hung on to him, but could not move him. At last at about 2 P.M. he gave in, and I landed him. A female fish 4 ft 7 inches in length, and 2½ ft in girth, weight 61 lbs. Caught on a 3½ inch silver and brass spoon and treble gut trace.'

42. *Thermometer*.—A small thermometer is a very useful article to include in one's kit, as the study of the temperature of the water

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\* From this remark the reader will be left with the impression that 150 yards of line is sufficient and that my estimate of the fighting powers of the large fish are grossly exaggerated. These fish are, I believe, mostly taken on paste, and have resorted to bottom feeding, living a lazy life and gone to seed, as this is certainly not characteristic of the mahseer of northern India, Assam or Burma, taken on spinning bait.

is a very big consideration. Note down what it is when fish are well on the feed, and when not. We have lots to learn about the almanac of fishes, and their feasting and fasting days.

43. *Photography*.—If developing in hot weather, when the temperature of the water is warm and likely to melt the dressing of a film, first of all wash in a solution of formalin 4%, this fixes and hardens a film and is a certain cure.

44. *Formalin*.—Formalin is the angler's friend, being useful for so many purposes. The collection of small fish as specimens, is a very simple matter and gives little trouble. Requirements: A bottle of formalin (formaldehyde) as sold by chemists; a coil of Zinc foil; a reel of thin copper wire; two wide mouthed bottles (Prune Jars); one or more empty one-pound biscuit tins.

The specimens should be washed in clean water, after making as small a cut as possible in the belly, to remove intestines, and wiped dry. Then place in a bottle containing clean boiled water (cold) 20 parts; formalin 4 parts. After a few days change to the other bottle, in which there is similar lotion. Then remove to the biscuit tin, wrapping each specimen in a piece of linen soaked in the solution, and pack after the manner of sardines. Specimens should lie straight, and therefore not be longer than the biscuit tin. Each specimen before going into the first bottle, must have attached to its tail (by passing a piece of wire through the fleshy part), a  $\frac{1}{2}$  inch square zinc label numbered, to correspond with entry in the note book in which are the following particulars:—Serial number, locality latitude, name of rivers, stream or lake, local name of fish, size to which said to grow, nature of stream or water, food, habits, etc., any remarks.

A copy of entries goes with each tin, which is soldered down and despatched by registered post to 'The Curator of the Bombay Natural History Society, Bombay.'

At the commencement of the collection, the strength of the solution should be watched and increased if necessary, for good preservation. The nose will test this, care should be taken to use as weak a solution as is compatible with proper preservation; for strong solution causes too great a change in colouration.

Meat painted with it will keep longer in the heat. Fish can be preserved for specimens for museums. Dead bait can be preserved for months in it; it is a very handy thing to have by one. See under (24) ante for removing formalin taint.

45. *Borax*.—Obtainable in any bazaar. In warm weather wrap your butter in a piece of muslin dipped in 2% solution of borax, and it will remain hard.

46. *Tackle Boxes*.—Allahboy Vallarjee, Multan, makes up excellent tackle boxes. They are strong and last for ever. It is the best tackle box I have seen, and costs with two trays Rs. 30/-

There is no better tackle bag than the British troop's webbed haversack, obtainable on payment from the Quarter Master's stores of any British Regiment.

47. *Fishing stools*.—The ordinary 'Mora' made from the tough grass common in India, obtainable in most towns for a few annas, adds much to one's comfort while fishing from a boat.



48. *Best Books on Fishing and Sport in India:—*

1. '*The Rod in India*' by H. S. Thomas, published 1897. Undoubtedly the most complete book ever written on Indian fishing.
2. '*Tank Angling*' by the same author, has useful information for the beginner.
3. '*The Angler's Hand Book*' by G. H. Lacey, published in 1905. Has a number of maps of good localities, and deals chiefly with the north of India.
4. '*The Angler in India or Mighty Mahseer*' by Skene Dhu, published in 1923. Has 400 pages devoted to localities all over India.
5. '*Hints to Amateurs in Tank Angling*' by P. N. Bhattacharyya. This is the best guide I know on this form of fishing.
6. '*Game Fishes of Bombay, The Deccan and Neighbouring District*' by Sir R. Spence and S. H. Prater.

Besides these books there are certain clubs that have magazines issued quarterly or annually, dealing with local areas or provinces. Chief among these are:

- (a) 'The Nilghiri Fishing Association', Ootacamund, South India.
- (b) 'The Dehra Dun Fishing Association', Dehra Dun, U.P.
- (c) 'The C.P. Angling Association', Jubbulpore, C. P.
- (d) 'The Myitkyina Fishing Club', Myitkyina, North Burma.

Other general books useful on a fishing or shikar trip:

- (a) 'Identification of Indian Butterflies' by Brig. W. H. Evans.
- (b) 'Identification of Poisonous Snakes' by Wall.
- (c) 'The Book of Indian Birds' by Salim A. Ali.
- (d) 'Popular Handbook of Indian Birds' by H. Whistler.

Big Game and Shooting books:

- (a) 'Wild Animals in Central India' by Dunbar Brander.
- (b) 'Big Game Shooting in the Indian Empire' by G. H. Stockley.
- (c) 'A Game Book for Burma' by E. H. Peacock.

49. Newman & Co., Calcutta, in 1919 made up for me an excellent Log Book, 9½ by 8½ inches of strong paper and bound in leather. Small leather tags show different compartments, the left hand sheet ruled off in manner shown on specimens, the right hand sheet left blank for notes. Under the four headings:

Fishing. Small Game. Big Game. Pig Sticking.

50. *Sealing Wax*.—A few sticks of Sealing Wax in various colours are handy for painting spoons. These dissolved in spirits of wine make the best paint for spoons.

51. *Enamel Paint*.—Good enamel paint is available in most Indian bazaars and is sold in convenient sized tins. They cover a wide range of colours.

52. *Packing and carriage of fish*.—Directly a fish is taken out of water, it should be killed, disemboweled and cleaned (not with water), with a bundle of grass or dry cloth. The inside should then be sprinkled with charcoal and salt alternately. Oil rubbed over the inside surface is also used. In England stinging nettles are much used for packing fish, it greatly preserves the bloom and freshness.



## FISHING

DATE	LOCALITY	FISH	WEIGHT	GIRTH AND LENGTH	BAIT AND TACKLE	REMARKS

## NOTES

53. *Protecting flies from the ravages of insects.*—

1. Napthaline crystals efficiently protect Salmon flies from insects. Fill a small pill box with powdered crystals, then cover over with a double layer of muslin instead of the lid, and place with the flies. The crystals must be replenished every few months, as they evaporate. Flies keep better in a tin case than in an ordinary fly book.

2. Keep your flies flat between layers of silver paper, in a close shutting tin box, and they will keep for years. If the tinsel gets tarnished rub it gently with a piece of soft wood (wedged off to a point), with a little plate powder, to regain its brightness. In both instances exclusion from light and air is essential.

54. *Dyeing Gut.*—To dye gut green, boil a strip of green baize with a small piece of alum, while the liquid is still warm place the gut in it, and allow it to stand for a few hours.

To dye gut blue, heat some ink and in it soak the gut. Do not allow it to stand too long. 20 minutes is enough. It can be stained to any degree of colour, depending on the mixture. A strong decoction of tea, well boiled will stain gut; use in the same way as ink.

55. *Manufacture of Silk Worm gut.*—Messrs. S. Allcock & Co., of Redditch, England, have published an interesting article in their fishing tackle pamphlet on gut, which reads as follows:—

'This is perhaps the most curious and interesting of the many departments in the manufacture of fishing tackle. All anglers make use of silk worm gut, but large numbers are quite ignorant of its origin. In some parts of the kingdom it is called Indian weed, and looked upon as a species of grass, and any attempts to prove its being really the entrails of an insect are derisively resisted. The breaking strain of salmon gut when made into casts is as under:—

Sizes	...	1/5	2/5	3/5	4/5
Breaking strain	...	15	12	10	9 lbs.

Lake and trout casts:—

Padron	Regular	Fina	Refina	1x Drawn	3x Drawn.
8	7	5	4 lbs.	3	1 lb.

Gut is made from two small organs situated in the body of the silk worm. These organs contain the silk before it is developed or has been spun by the silk worm; great nicety is entailed in taking the worm at the proper time, otherwise the gut is useless. The worms are thrown into vinegar, and there left for some hours. This process kills the worms and solidifies the organs. These are now taken out of the worm, and pulled out as far as they will go, from end to end. These organs thus extended, being in fact 'the gut', are now left to dry. They are in this stage more or less rough and stringy, but are polished and finished off with some soap and a little soda. According to the size of the organ, so depends the thickness and length of each strand of gut. The strands are then sorted and laid out according to thickness. Gut is, therefore, nothing more than solidified silk; thick gut is doubtless made from larger worms, which are difficult to obtain, and hence the cost is much increased. 'Drawn' gut is very fine, and is made by scraping it down and drawing it through a gauge or standard.

Messrs. Hardy Brothers produce in their Anglers' Guide, some interesting facts of experiments on gut, which I reproduce:—

'Gut or gut casts cannot be tested with a view of giving a guaranteed breaking strain, but in order to give some tangible idea as to the strength of good gut, elaborate experiments have been carried out in a Science department of one of the Universities. The apparatus used measured simultaneously the strain applied and the elongation produced. These results must be taken as a general guide and not in any form of a guarantee.

The following details from an article in *The Field* are extracts from these tests:—

1. The strength of gut is surprisingly high, calculated from minimum and maximum data actually observed, breaking at 17-23 tons per square inch.

2. The strength of gut is chiefly dependent on the rate of smooth continuous loading. No comparison between the strength of specimens can be made unless the rate of loading is kept constant in all such experiments.

3. The strength increases the higher the rate of loading. Thus a test piece of 2x cast which broke at 3.4 lbs. when the rate was 8.1 lbs. in 100 seconds, broke at 5 lbs. when the rate was 8.1 lbs. in 50 seconds. The bearing of this on the sudden strain involved in striking a fish is obvious.

4. Although of no practical interest to anglers, it was found that dry gut was stronger than damp.

5. The diameter of the casts varied but slightly throughout their length; it increased slightly on damping, and was very constant.

6. The table below gives the smallest breaking stress which was observed in testing various sizes of gut. The average strength would be higher in all cases, but the tests actually made on small pieces cut from the various casts shewed that these would have broken at the loads given in column 3.

Designation of Cast.		Diameter in Inches.	Strength in Lbs.
4x	...	... .006	1.5
2x	...	... .009	2.7
0x	...	... .011	3.5 (another 4.4)
7/5	...	... .013	6.3
6/5	...	... .015	6.6

7. As the stress was applied to the test pieces they elongated, the instrument registering an elongation of 10 per cent. per piece before breaking.'

56. *Knots for tying Gut, Flies, Hooks, and Lines.*—The variety of knots used by fishermen is numerous, and each angler has his own favourite, to which he attributes advantages over all others, so that for purposes of choice, I have listed 24 varieties in diagram, which can quite easily be followed by placing the diagram before one, and with one or two pieces of line the fancied knot can be practiced and mastered. I have mentioned my choice in Chapter V.

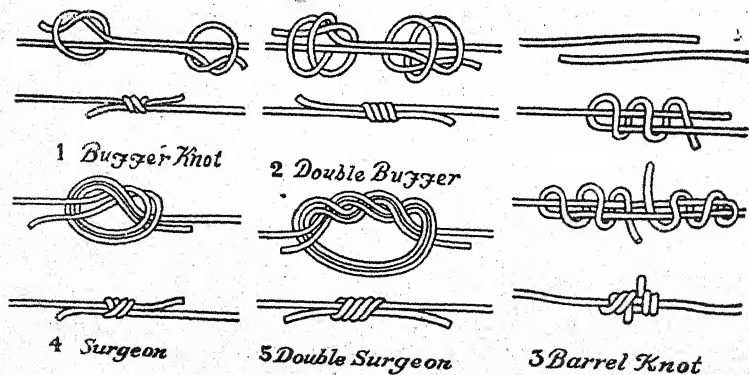


Fig. 5. To tie two strands together.

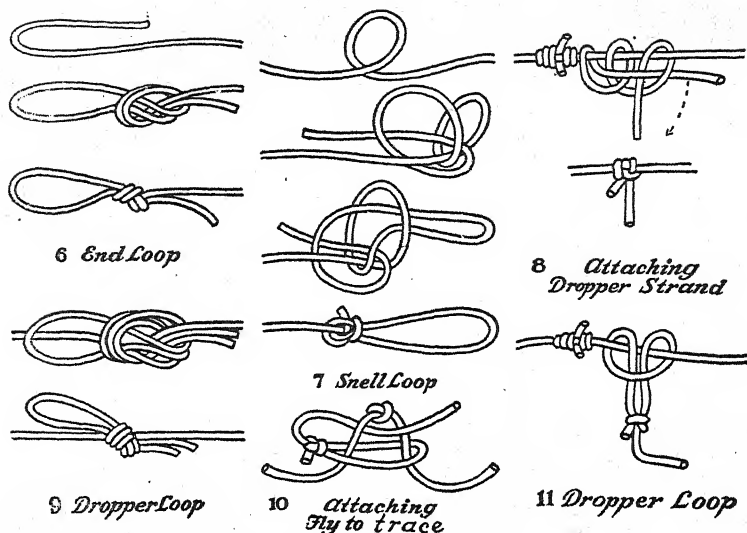


Fig. 6. To tie Loops in Gut.

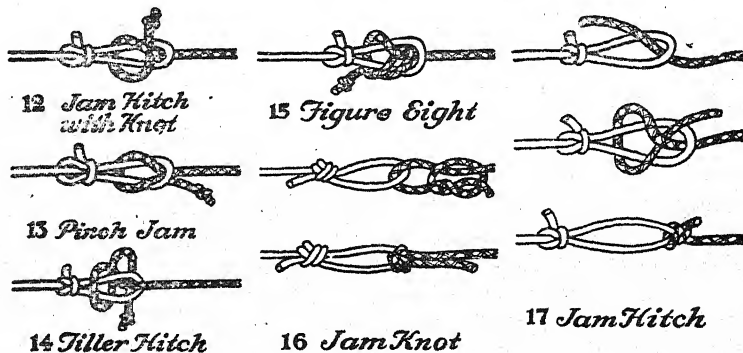


Fig. 7.—Attaching Line to Trace.

## 57. Nylon for casts.

From *The Field* dated May 27, 44:—

'I think the difficulty of knotting Nylon has been grossly exaggerated. It has been made to appear a sort of voodoo rite which only a witch doctor can perform. Th's is not my experience at all. For trout and sea trout flies I find an ordinary Turtle knot perfectly satisfactory. For salmon flies the knot made by passing the gut through the eye, over the neck of the fly and back through the eye and finishing off with a half hitch seems perfectly safe.

For joining two lengths the double fisherman's knot has served me faithfully. I recently received some Nylon from America, and the firm which made it, one of the Pioneers of Nylon for lines and casts, recommend the single fisherman's knot for joining two lengths. Anyway after the war Nylon will be obtainable in long lengths. I have some 10-yard lengths now, and so the knotting problem will be less acute—if it ever really was.'

58. Garters.—I find I can never keep my stockings up for long, while wading about in rapids. I have tried the ordinary woollen gart-

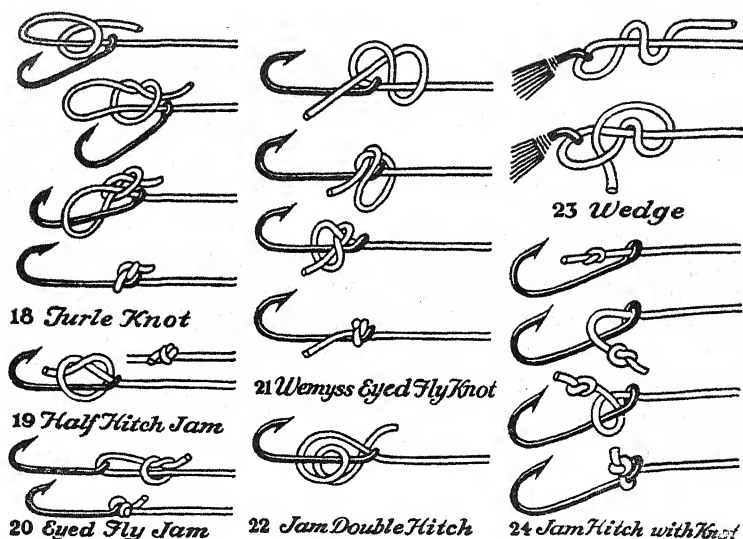


Fig. 8.—Attaching Gut to Flies or Hooks.

ers, and elastic, and have now resorted to cutting strips of rubber cross section, through an old inner tube of a tyre, and find they work excellently.

59. *Ankle Puttees*.—Puttees tied over the boots will save many a sore patch on the foot, as however careful one is in tying a boot, shingle, coarse sand and gravel will find its way in through the top.

60. *Sore Toes and Feet*.—With constant wading the feet are sometimes apt to get very sore between the toes, and a form of eczema, rather similar to 'Bengal Rot' attacks the skin of these parts. Grease freely applied will save the feet to a certain extent. Frank Ross & Co., Chemists, Calcutta, make a special ointment for the infection, which I thoroughly recommend. I have found the water so bad in some rivers, that both the boatmen and I were hardly able to walk. The local fishermen told me that if the water is at all discoloured, from storms in April/May, they rub mustard oil over their legs and feet before wading. This curious condition is apparently caused by rotten vegetation or toxic salts being washed into the river. Oxide of zinc powder will disinfect and dry up the sore places between the toes.

61. *Sun Burn*.—Vaseline rubbed over the face, hands and knees, will save peeling and blisters, and much discomfort, if one is not accustomed to the sun. It sounds a messy job, but is really not as uncomfortable as it sounds.

62. *Glare Glasses*.—Sun glasses are very necessary, as one is facing the sun most of the morning and evening (that is if fishing correctly) and the glare off the broken water in a rapid, is intensified, and most trying. Care should be taken to see they are strictly *neutral*. The recently invented 'Polaroid' glasses enable one to see under the surface of the water.

63. *Topee*.—A topee of the Pigsticker type, with a large brim and worn back to front, protects your face. The usual small ventilation holes can be enlarged by insertion of cut revolver cartridge cases, much to the cooling of one's skull.

64. *Jacket*.—A sun proof or khaki drill sleeveless jacket, with lots of pockets that button, is handy for carrying small pliers, scissors, a small tin with fly spoons, swivels, split rings, etc. The buttoned pocket will save losses one can ill afford, as tosses are inevitable while wading.

65. *Tackle Outfit*.—Do not try to buy a complete outfit of tackle, all at once, it hits the 'exchequer' rather hard. Get the few necessities, and add to them each year. A good way of doing this, is to give yourself a birthday or X'mas present, or better still give your wife a nice rod or reel, when her birthday comes along!!

66. *To Skin and Preserve a Mahseer*.—With acknowledgements to Van Ingen and Van Ingen Taxidermists, Mysore:—

'Lay the fish on a board, and make an incision—not down the belly—but along the centre of the side from gill to tail, the heavy bone or scapular arch under the gill covers being cut through at this point, the object being to remove the body from the skin with as little disturbance of the scales as possible.

When skinning, leave plenty of flesh attached to the skin. This can be removed later and do not lift or pull the skin in any way as it is apt to displace the scales.

When the back is reached, place the point of the knife against the base of the fins, and strike the back of the knife smartly with a block of wood, and the obstruction can in this manner be cut through easily.

The body should be disjointed near the head and tail and removed in pieces. The gills, tongue, eyes and all the bones, etc., inside the head be cut clean away. The flesh on the cheeks is covered with very delicate skin. All this flesh should be carefully removed, but from inside the head, so that this skin is not injured.

The head, when finished, should be just a shell. The lips, which are very thick, must have incisions made inside to allow the preservative to get well in. While cleaning the head, particular care should be taken not to bend it back over the skin where it joins the head which is quite narrow and this is where the scales always come away.

After cleaning the skin thoroughly of all flesh and fat, paint the inside with arsenical soap and fill lightly with straw, and small sticks arranged lengthways which will prevent the head being bent over accidentally, and draw the edges together with a few stitches. The skin will then dry in some shape. The fins need not be spread out to dry. A little arsenical soap may be applied to these also. Never use salt or alum. Arsenical soap is the only suitable preservative for fish. Save any of the scales which may happen to work loose.'

67. *Medical*.—Fishermen journey to wild places, far from medical assistance, so should have some knowledge of medicines and first aid. The local jungle people will call for it, and help given will be greatly appreciated. The following list is offered as a guide, which can be added to or altered, according to individual ideas and requirements:—

#### 68. *Medicines*.—

Boric powder: Camphorodyne.

Essence of ginger for stomach colic (servants often need it). Tartaric acid and Chlorate of Potash for scorpion stings.

M. and B. 693 tablets for pneumonia and lung troubles.

M. and B. 720 tablets for septic wounds and pneumonia.

M. and B. 125 tablets for septic wounds.

(a) Calomel 1-grain tabloids.  
 Cascara. 2-grain tabloids.  
 Epsom Salts.  
 Quinine. 5-grain tabloids.  
 Mepacrine.  
 Salicyllate of Soda. 5-grain tabloids (for Rheumatism).  
 Genaspirin or Aspro.  
 Tinc. Benzoine. Co.  
 Hydrogen Peroxide.  
 Germoline.  
 Iodex.  
 Winter Green.  
 Oriental Balm.  
 Iodine. Rect.  
 Essential Oil (for Cholera).

*D.D.T.*—One of the greatest discoveries of the War and responsible for the saving of thousands of lives from Malaria and discomfort from crawling creatures.

5% solution sprayed in the room or tub or to the walls or sides will kill all insects and small creatures that come in contact with the sprayed surface for 10 days. It may well revolutionise poultry farming and rid the rooms and house of ticks that pester the canine species during the hot weather.

*Mepercrine*.—Yet another discovery of the War against Malaria, it has no taste or ill effects except perhaps a yellowing of the skin, but for risk of visits to water and jungles that would otherwise be death-traps in north of India.

(b). Appliances.

Bandages.  
 Eye bath. Eye lotion, Sulphate of Zinc, 2 grs. to ounce of distilled water.  
 Lint.  
 Cotton wool.  
 Permanganate of Potash crystals.  
 Resinol ointment (for burns and wounds).  
 Surgical knife, scissors, needles, silk in sterilised bottle.  
 Two thermometers.  
 Glass syringe in bamboo case.  
 Z.O. Plaster.  
 Prontosil (for sceptic wounds).

69. *Wounds*.—Should be washed by some antiseptic, Peroxide or E.C. Carry a curved surgical needle in case stitching should be necessary. Ordinary gut does excellently for this purpose, in the absence of Suture silk.

70. *Foul Hook*.—I have had the misfortune of having a hook cut out of my calf with a blunt penknife, with two massive beings sitting on top of me, so offer a more kindly way as a suggestion. Take a pair of wire cutting pliers, and snip off the hook below the barb, slightly above where it has buried itself, apply a hot fomentation or poultice, and after this has cooled, push the point through the skin forward, DO NOT TRY TO BRING THE BARB BACK THROUGH THE HOLE IT MADE ON ENTERING, or you will suffer agony, and make a nasty mess. Apply iodine, and the wound will heal quickly. If the seat of the wound permits of an incision being made, make a cut along the hook, and it will come away.

71. *Bleeding*.—To check arterial bleeding apply pressure above

the wound, by bandaging or a tourniquet, but if the tourniquet is kept on for more than 20 mins. at a time, without release, there is danger of gangrene. Make sure you have stopped the bleeding, before bandaging the part, or serious loss of blood may result. Tincture of steel applied to the wound, is the best remedy I know. A copy of Moore's Family Medicines for India should be carried in one's kit.

72. *Blisters*.—Never cut or remove the skin, prick on one side and allow the liquid to flow out. Homoeoa is a good dressing. To ease the feet on long marches on hot days, boric powder dusted into a silk sock will generally prevent blistering of the feet. Zinc ointment plaster (z.o) over a blister or shoe bite on heel or toe, will enable you to walk in comfort, instead of being dead lame; and the part heals under the plaster which does not come off while bathing or washing. This plaster is invaluable for all small cuts and wounds, also excellent as tape for splicing Castle Connel pattern rods.

73. *Boils*.—Boils can be brought to a head with mixture of soap and sugar, and burst by hot poultices.

74. *Stings. Scorpion Stings*.—The best cure for scorpion sting is the immediate application on the seat of the sting, of a pinch of permanganate of potash mixed with a powder of equal parts of Tartaric Acid and pot. Chlorate. Then apply a few drops of water, leave on for as long as the patient can bear it, then apply water freely. This is a drastic treatment, and may leave the seat of the sting sore and blistered, but it will give relief from the hours of pain otherwise suffered. Keep the permanganate and the other powder in separate bottles, and only mix when applying to a sting.

75. *Septic wounds from Tiger and Panther*.—A very serious thing at any time. Epsom's salts freely applied to the wound is effective (in powder form); but best of all, if you can obtain it, is Prontosil. A German preparation, sold in tubes. Hurry off the patient to the nearest hospital, as blood poisoning is almost always the result. M and B. 125 is now the remedy. This is the same as Prontosil not now procurable.

76. *Fever*.—Prevention is better than cure. Whisky and Quinine are good in moderate doses, for one's self, and quinine for the followers. But I find a good day's fishing and Whisky 'dawai' in the evening, with a flitted net to sleep under, is good enough precaution.

77. *Drowning*.—Artificial respiration, if applied correctly, will often bring a patient round, and should be tried out on any case with any visible signs of life.

Professor Schafer's method which is adopted by the Metropolitan Police, and also by the Royal Life Saving Society, is the best. Professor Schafer's method has two very great advantages. First the patient is laid in a prone position, thus obviating the danger of the tongue falling back and blocking up the Pharynx and at the same time helping in the escape of any water remaining in the lungs; and secondly, far less labour is necessary. The whole procedure is exceedingly easy, and there is no risk of any injury to any of the internal organs, and it has this further advantage,



that no time need be lost after recovering the patient from the water while removing clothing. But Schafer's method must be applied with some care—rough or hasty usage may result in fracture of the ribs with perhaps fatal results.

The patient should at once be placed face downwards on the ground, with a folded coat or rug if obtainable, under the lower part of the chest, the arms extended in the front, and the face slightly on one side, so as to keep the mouth clear. The operator should place himself on one side of the patient's body in a kneeling position, and facing his head; his hands should be placed flat over the lowest part of the back (on the lowest ribs) one on each side, and the weight of the operator's body should be gradually thrown forward on to the hands, so as to produce firm pressure—which must not be violent—upon the patient's chest. In this way, if there is any water, it is driven out of the patient's lungs.

Immediately afterwards the operator's body is raised slowly, so as to remove the pressure, the hands being kept in the same position. This forward and backward movement (pressure and relaxation of pressure) has to be repeated every four seconds, 15 times a minute, so as to approximate to the natural process of breathing. These movements should be continued, according to Dr. Schafer's instructions, for at least half an hour, or until the natural respirations are resumed.

Shock from lightning, if not serious, should be treated in the same way.

#### 78. *A wife's point of view.*—From THE WOMAN,

'T-t-turn the p-point of the b-boat to the p-p-point of that island!' suddenly stutters my husband. He has just seen a swirl on the water, indicating that a trout is on the move.

Now, what is the perfect wife to do? Around us there are three islands, each of which possesses two points. The boat, not being of the square-sterned variety, has two points. Therefore, I have to choose the correct direction out of twelve possibles—and in about the fifth of a second.

Just let me tell you a few of the things expected of me when on the loch with my husband.

I am expected to have a complete and detailed knowledge of the loch, its deep places, its shallow and its skerries. In fact, I must know the bottom of the loch as completely as I know my permanent wave. I am expected to be a first-class oarsman, and must be able instantly to translate a vague wave of the hand into a complicated piece of navigation.

I am expected to fill his pipe exactly to his liking—which is not so easy as it sounds—and I must even light it for him sometimes.

On the few occasions that my husband does hook something, I am apparently expected to fold up the oars and put them out of the way into my handbag.

I am expected to come off the loch feeling bright and cheery after several hours of cold, bleak monotony.

Yes, this fishing is a queer business. At home, my husband is rather faddy about things. The table-cloth must be spotless, the silver must be shining, the glasses must be polished. The tea-table must be 'just it.' Bread must be cut thin and cake thick. Yet, on the loch, he will cheerfully eat sandwiches out of a grubby bag and he will cheerfully drink 'thermos tea.'

At home, an expensive easy chair cannot soothe his limbs. He is restless; he fidgets. First he flings one leg over one arm of the chair; five minutes later he twists around and flings the other leg over the other arm. I often ask him if he would not like to lie on the mat. But, on the loch, he will sit happy for hours on a cold, HARD board. . . .

Why do I do it? Well, m'dear, look at these ducky little fishing hats I wear and, believe me, you can get the most gorgeous sunburn on the loch!

## 78.—ADDENDUM TO CHAPTER 'SCRAPS FROM MY NOTE BOOK'

For easy reference and convenience, the following blocks, kindly lent by Messrs. Hardy Brothers, Alnswick, England, have been included, with a few details of gut, wire, etc.

## GUT SIZES AND DESCRIPTIONS.

<i>Size</i>	<i>Name of Size</i>	<i>Description</i>
·021 and above	...	Crown
·020	Extra Stout Salmon	... 0/5
·019	Stout Salmon	... 1/5
·018	Fine Stout Salmon	... 2/5
·017	Medium Salmon	... 3/5
·016	Fine Medium Salmon	... 4/5
·015	Fine Salmon	... 5/5
·014	Extra Fine Salmon	... 6/5
·013	Stout Grilse	... 7/5
·012	Grilse	... 8/5
·011	Heavy Lake	... 9/5
·010	Medium Lake	... 0×
·009	Fine Lake	... 1×
·008	Stout Trout	... 2×
·007	Medium Trout	... 3×
·006	Fine Trout	... 4×
·005	...	... 5×

In the specification of all casts listed, the above descriptions are referred to as the thickness of the Casts.

## NATURAL GUT IN HANKS OF 50 AND 100 STRANDS.

For those wishing to make up their own traces the following note will help when ordering Gut:—

REFINA.—Fine work.  
 FINA.—General trout fishing.  
 REGULAR.—Heavy Trout and coarse fish.  
 PADRON. 2nd.—Trout Spinning traces.  
 PADRON. 1st.—Sea Trout and light grilse.  
 MARANA. 2nd.—Grilse.  
 MARANA 1st.—A light Salmon gut.  
 IMPERIAL.—General Salmon work.  
 ROYAL.—The heaviest gut.

The best sizes for Mahseer are those listed as 'Fine Stout Salmon' to 'Heavy Lake' sizes 2/5 to 9/5.

## WIRE FOR TRACES.

## 'Punjab' Cable-laid Steel Wire.

Made in 8 sizes as below, in coils of 5 yards only.

Colour Black, plated and oxidized to prevent rust.

No. 0	
„ 1	
„ 1½	
„ 2	
„ 3	
„ 4	
„ 5	
„ 6	

Fig. 9.—Breaking Strain.

No. 0	... 19 lbs.	No. 3	... 70 lbs.
„ 1	... 28 lbs.	„ 4	... 85 lbs.
„ 3	... 35 lbs.	„ 5	... 130 lbs.
„ 4	... 50 lbs.	„ 6	... 200 lbs.

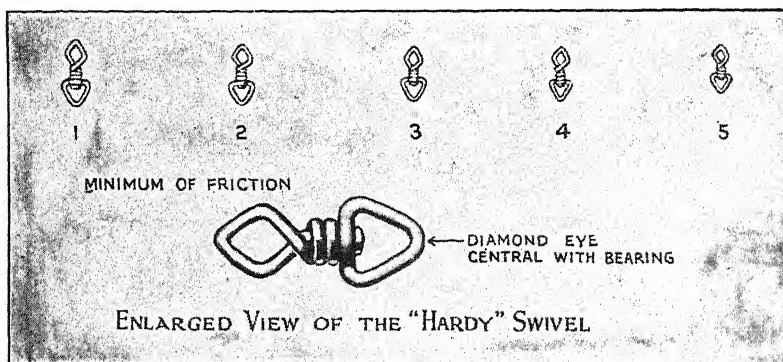


Fig. 10 (a)—The 'Hardy' Swivel.

(Is ideal for mounting Fly Spoon).

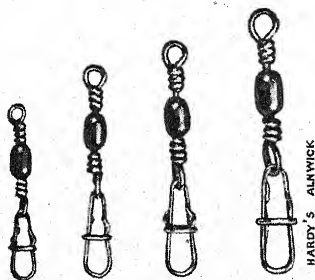


Fig. 10 (b)—The Safety Clip and Close Box Tested Swivel.

(For loading and mounting spoons, such as the Myitkyina Spoon).

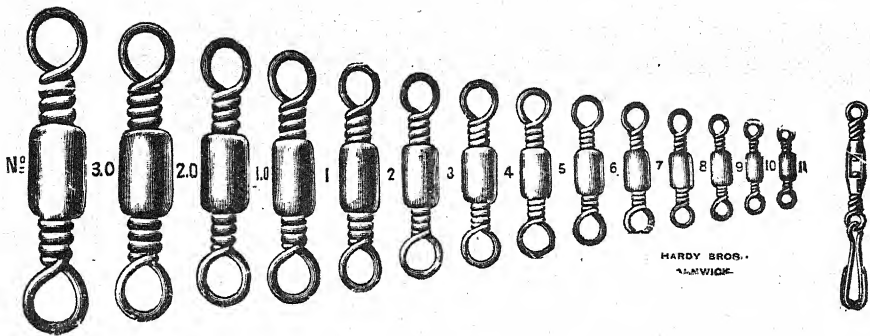


Fig. 11.—Size Scale of Swivels (Standard).

Link Swivel.

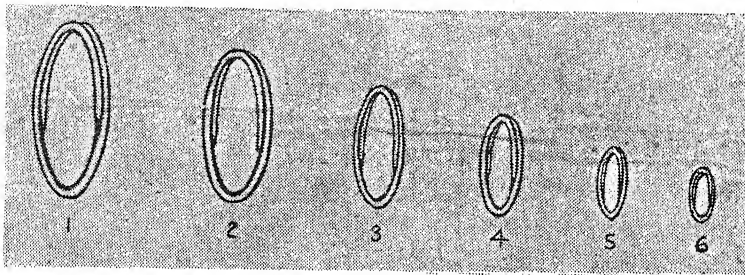


Fig. 12.—Hardy 'Attachment' Links.

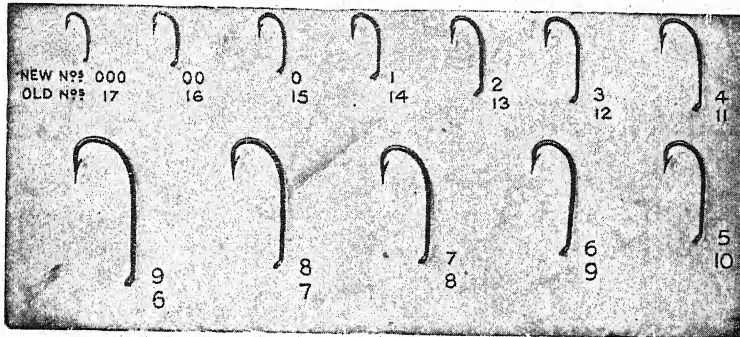


Fig. 13.—(Single Hooks) Old and New Scale.

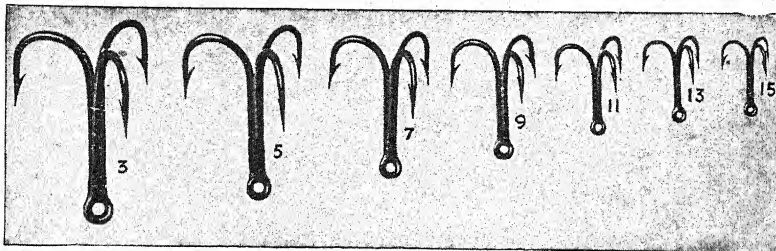


Fig. 14.—(Treble Hooks) Ordinary Scale.

# Hardy's Patent "OVAL" Wire Double and Treble Hooks

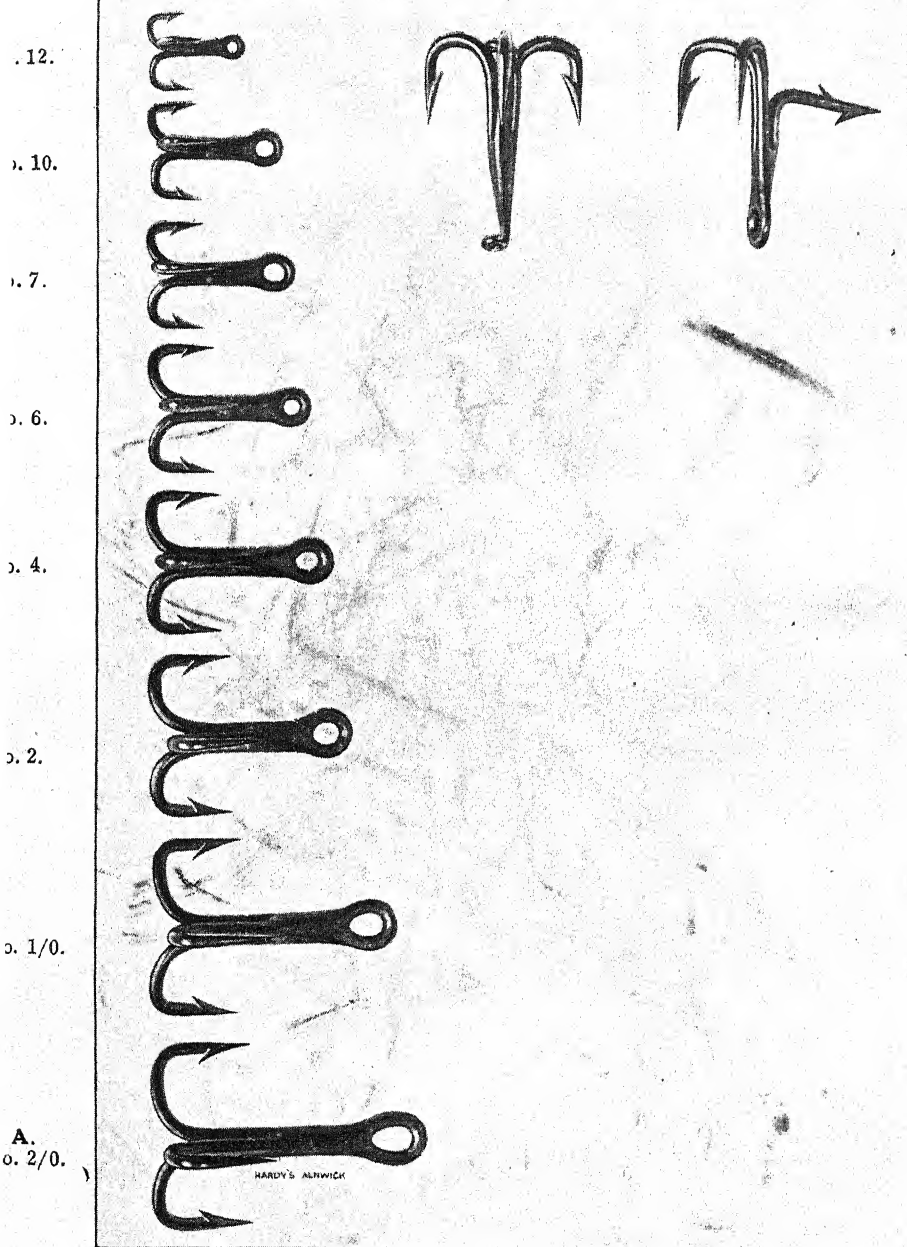


Fig. 15.—Hardy's Patent 'OVAL' Wire Treble Hooks.

Extra strong 'Oval' wire. The Best Treble for Mahseer.

A.—Trebles Tapered or eyed.

B.—Double eyed Self-fastening Trebles.

C.—Doubles, spiked, with eyes or tapered.

'T-t-turn the p-point of the b-boat to the p-p-point of that island!' suddenly happy for hours on a cold. HARD board. . . .

# THE EARLY STAGES OF INDIAN LEPIDOPTERA.

BY

D. G. SEVASTOPULO, F.R.E.S.

## PART XIV.

(Continued from p. 198, Vol. xlv.)

### RHOPALOCERA.

#### PIERIDAE:

*Catopsilia pomona* F.

de Nic., *Journ. As. Soc. Beng.*, lxix, 251. 1900.

Bingham, *Fauna Brit. Ind.*, Butterflies, ii, 221. 1907.

Talbot, *Fauna Brit. Ind.*, Butterflies (2nd edit.), i, 495. 1939.

Head green with minute black dots. Body green, the skin very rough and shagreened, the points black. A white spiracular line, above which is a dotted black line and below which is a subspiracular olive green stripe. Venter whitish green. In larvae reared in captivity the black lateral line often develops into a wide black stripe extending to the subdorsal area.

Pupa boat-shaped, the thorax slightly keeled and the head produced to a point. Colour apple green, a yellow line on the thoracic keel and another from the head along the dorsal edge of the wing case and laterally along the abdomen to the cremaster. A dorsal blue line on the abdomen, often very faint. Cephalic point yellow with a black spot at the apex. A faint black line across the eye. Suspended by a girdle and tail pad of white silk.

Food-plant—*Cassia fistula* L. and *C. siamea* L.

Described from a full fed larva found in Calcutta 17-ix-43, pupated 19-ix-43, and a female emerged 24-ix-43.

de Niceville, Bingham and Talbot all quote a description by Bell which gives various points of difference between the pupa of this species and that of *C. crocale* Cr. I have been quite unable to detect the difference in the thoracic angle mentioned, and the black line across the eye is common to both species, not present in *crocale* and wanting in *pomona* as stated. The 'white spiracular band touched with bright yellow on segments 2 to 5' is only found in larvae preparing to pupate, earlier the stripe is white without any yellow.

#### SATYRIDAE:

*Elymnias hypermnestra* L., *undularis* Drury.

Sevastopulo, *Journ. Bomb. Nat. Hist. Soc.*, xl, 397. 1938.

Ovum—Almost spherical, slightly higher than broad. At first creamy white, later yellow. Laid singly on palm fronds, above or below.

1st instar—Head black, terminating above in two short tubercles surmounted by a black spine, two more spines and the vestiges of a third spaced equally, and projecting outwards, between the tubercle and the jaws. When first hatched body pale yellow, after feeding pale green with a darker dorsal line. Under a lens seen to be clothed with sparse colourless hairs, each holding a drop of liquid. Anal processes pale green and terminating in a black bristle.

2nd instar—Similar. The cephalic tubercles larger and branched, the two lateral spines stouter, the vestigial spine obsolete. Body with a yellowish double dorsal line, subdorsal stripe and lateral line. Anal processes blackish.

3rd instar—Similar.

4th (penultimate) instar—Head black with a yellow lateral stripe in continuation of the subdorsal body stripe, and a double pale yellow spot between the cephalic processes. Shape square, the processes larger and spined and a series of small spines along the sides of the face. Body as in previous instar. Anal processes pale orange above and black below, laterally greyish.

Described from larvae bred in Calcutta in October 1943.

#### NYPHALIDAE:

*Ergolis merione* Cr., *tapestrina* Moore.

Sevastopulo, *Journ., Bomb. Nat. Hist. Soc.*, xli, 312, 1939.

Ovum—White. To the naked eye like a speck of mildew, under a lens spherical with a flattened base and covered with fairly long spines, rather like a miniature sea-urchin. Laid singly on the underside of leaves of the food-plant.

1st instar—Head pale brown. Body whitish green with a transverse brown dorsal band on the 3rd, 6th and 10th somites. Head and body with black bristles in place of the branched spines of later instars.

2nd instar—Similar, but with the bristles replaced by short branched spines, all of approximately equal length.

3rd instar onwards similar to adult.

During the first two instars it feeds on the lower surface of the leaf, later on the upper.

Described from larvae bred in Calcutta in August 1943.

#### LYCAENIDAE:

*Chilades laius* Cr., *laius*.

Moore, *Cat. Lep. Mus. E. I. Co.*, i, 21, pl. 12, figs. 1, 1a. 1857.

de Nic., *Butt. Ind.*, iii, 89. 1890.

Bingham, *Fauna Brit. Ind.*, Butterflies, ii, 366. 1907.

Sevastopulo, *Journ., Bomb. Nat. Hist. Soc.*, xlv, 417, 1944.

Head small, black, shining and retractile. Colour pale, bright green. A darker green dorsal stripe, narrowing from front to rear, and edged by a paler line. Traces of a double dark subdorsal line. A pale subspiracular line. Ant gland and tubercles not prominent.



Clothed with short, sparse pubescence. The usual Lycaenid woodlouse shape. One larva had the dark markings replaced by deep purple.

When wild, attended by a very vicious, large, red ant, but did not seem to suffer from lack of its attentions in captivity, as all larvae lived through at least one complete instar before pupating.

Like many Lycaenid larvae, it is apt to eat its pupating and moulting companions.

The pupa varies considerably in the amount of black markings, those formed close together or on a dark background are heavily marked and have a certain amount of black suffusion, whilst those formed singly on young leaves are unsuffused and have the markings obsolete or nearly so.

Food-plant—*Citrus* spp.

Described from a full fed larva found in Calcutta 28-viii-43, pupated 31-viii-43 and a male emerged 5-ix-43.

Bingham gives the following description, quoting de Niceville, 'Pale green at all stages, of the shade of the young leaves of the lime and pummeloe bushes on which it feeds. When full grown it is about seven-sixteenths of an inch in length, onisciform as usual; the head black, smooth and shining, with a somewhat dark green dorsal line down the body, the whole surface but very slightly shagreened and covered with extremely fine and short downy hairs. The constrictions between the segments slight. There are traces of two pale subdorsal lines, and there is a pale lateral line below the spiracles. The usual extensile organ on the twelfth segment short. The larva has no distinctive markings by which it can be easily recognised; it is altogether a very plainly coloured and marked insect. I have found it common in Calcutta during the rains, the ant which attends it betraying its presence. The latter has been identified by Dr. A. Forel as *Camponotus rubripes* Drury (*sylvaticus* Fabr.) subspecies *compressus* Fabr. (Now known as *C. compressus* Fabr.)'

## HETEROCERA.

### ARCTIIDAE:

*Nola fuscibasalis* Hamps.

Head very pale brownish green. Body pale whitish green with a white dorsal stripe containing a median yellow line. A subdorsal, lateral and sub-lateral series of small tubercles tufted with pale hair, the sub-lateral series largest and with the largest tufts. The colour is an almost exact match of the underside of the leaves of the food-plant and the larva is extremely difficult to see.

Cocoon canoe-shaped, of felted, greyish-brown silk, with a distinct keel, the front truncate and surmounted by two short tufts of silk, sometimes the tufts are longer when there is a second double tuft towards the posterior end. A slit in front through which the imago emerges. Pupa pale olive green, the dorsum tinged with chestnut. Head and anal end obtuse.



Food-plant—*Zizyphus jujuba*.

Described from a full fed larva found in Calcutta 1-xi-43, spun 2-xi-43 and a male emerged 12-xi-43.

#### LYMANTRIIDAE:

*Dasychira pennatula* F. (*securis* Hbn.)

Moore, *Lep. Ceyl.*, ii, 95, pl. 115, fig. 1b. 1882-83.

Hamps., *Fauna Brit. Ind.*, Moths, i, 454. 1892.

Lefroy, *Indian Insect Life*, 460, pl. 39, fig. 7. 1909.

Gardner, *Indian Forest Records*, vi, 301. 1941.

Ovum—Straw coloured, almost spherical with the top depressed, micropyle an orange speck. Laid in neat batches and covered with a layer of dried froth. Laid 31-viii-43. Hatched 6-ix-43.

1st instar—Head black. Body blackish brown, the thoracic somites somewhat paler, clothed with longish, single, black hairs. 1st somite with subdorsal tubercles. After feeding becomes pale grey with transverse black bands on the abdominal somites. Dorsal glands orange. Prolegs orange.

2nd instar—Very similar, but the ground colour tinged with green and the single black hairs replaced by tufts of greyish.

3rd instar—Similar. Head grey, the clypeus and central part black. The thoracic somites with narrow black transverse bands. All the bands interrupted on the dorsum by a blue-grey spot. Tufts from the subdorsal tubercles on the 1st somite black. Hairs of the lateral tufts plumose.

4th instar—Similar, an intersegmental black transverse dorsal line.

5th instar—Very similar. The ground colour now a definite very pale greenish yellow. 4th somite with a minute rufous dorsal tuft. The grey-blue dorsal markings more extensive. 12th somite with a backward pointing fringe of long black hair.

6th (final) instar—Head grey, clothed with short silky grey hair. Ground colour pale yellow green, with intersegmental black lines and transverse black dorsal bands, 8th somite backwards with a black dorsal stripe. An interrupted blue-grey lateral stripe, immediately below which is a similar silver-grey stripe, the two separated by a black line. Below the silver-grey stripe are two series of black spots. 1st somite with black subdorsal tubercles, tufted with a pencil of long black hair, and a double dorsal wart, the whole with a fringe of forward-pointing grey hair. A subdorsal, lateral and sub-lateral series of greyish warts giving rise to tufts of pale cream hair, the sub-lateral series the densest and containing an admixture of plumose hair. 12th somite with a loose tuft of backward-pointing long black hair. 4th to 7th somites with short dorsal brushes of pale golden hair, each brush rising to a central point. Dorsal glands scarlet. Legs and prolegs orange. Venter blackish speckled with greenish yellow.

Food-plant—Grasses.

Described from larvae bred from ova laid by a Calcutta caught female. All my larvae died soon after entering the final instar, possibly through feeding on too lush grass.

Moore's description is 'Larva black, with a few ochreous hairs along the back and black hairs from the sides, two long tufts of black hairs projected in front of the head and a tuft from anal segment; a short dense dorsal tuft of red hairs on fifth to eighth segments, and a smaller tuft on tenth and eleventh segments; a dorsal and lateral row of green spots, and a similar coloured lower lateral line; head and legs red. Cocoon fusiform, olivaceous green. Pupa olivaceous green, hairy, thorax and wing cases black, abdominal segments with longitudinal black streaks', and this forms the basis of Hampson's description. The dorsal tufts in Moore's figure are dark brown, not red. Lefroy gives an almost unrecognisable figure and no description, but states that it feeds on cereals, grasses, crucifers and other cultivated plants.

## SPHINGIDAE:

*Acherontia lachesis* F.

Sevastopulo, *Journ. Bomb. Nat. Hist. Soc.*, xlv, 419. 1944.

Brown form—Head pinkish ivory, clypeus outlined in black, a double black line from just outside the clypeus to vertex, and a broad black lateral stripe. Thoracic somites with a broad, olive-brown dorsal stripe, darker at both ends and widening from front to rear and with a whitish median line. An ivory white subdorsal stripe, the lateral area olive brown mottled with darker. Abdominal somites with the dorsal area clay brown, the secondary segmental rings with lines of very minute white-ringed black specks, these specks increasing in size and density on the lateral and ventral areas and also from the 11th somite backwards. A subdorsal blackish spot on the anterior edge of somites 4 to 10. Traces of a blackish spiracular stripe. Spiracles black, very narrowly ringed with yellow. Legs black, speckled with pinkish. Prolegs black. Anal claspers and flap deep olive brown with a pale border. Horn olive brown, the tubercles ivory pink. Thoracic somites with the ridges rather more noticeable than in the green form.

Food-plant—*Duranta ellisii* (Verbenaceae).

Described from a full fed larva found in Calcutta 4-ix-43, buried itself 6-ix-43 and a male emerged 27-ix-43.

*Theretra clotho* Drury, *clotho*.

Hamps., *Fauna Brit. Ind.*, Moths, i, 93. 1892.

Hamps., *Ill. Het.*, ix, 57, pl. clxxv, fig. 10. 1893.

Mell, *Biol. u. System. der Sudchin. Sphing.*, 294, pl. xix, figs. 9, 10, pl. xxxi, figs. 8, 9. 1922.

Seitz, *Seitz Indo-Austr. Bombyces*, x, 565. 1929.

Scott, *Journ., Bomb. Nat. Hist. Soc.*, xxxv. pl. iii, fig. 3. 1931.

Bell & Scott. *Faun. Brit. India.*, Moths v. 435, pl. v, figs. 18, 19, 20, pl. xii, fig. 5, pl. xv. fig. 12. 1937.

3rd instar—Head green. Body green, abdominal somites from posterior half of 5th somite backwards minutely speckled with darker. 4th somite with a subdorsal ocellus consisting of a pale

blue pupil, palest in the centre, surrounded by a cream ring, wider below than above, and the whole edged by a black line, wide below, very narrow at the sides and above. Traces of a bluish dorsal and a yellowish subdorsal line from the middle of the 5th somite and meeting at the base of the horn. Horn purplish, a black basal spot, the extreme tip whitish, covered with minute hairs, long and straight, and capable of being moved up and down. Spiracles brownish purple. Legs yellowish. Prolegs green. First four somites tapered.

4th instar—Similar, but the ocellus on the 4th somite consisting of a horizontal white linear pupil in a green iris, the whole surrounded by a cream ring and edged with dark blue above and black below. Legs reddish banded with yellow. Horn paler than in previous instar and without the black basal spot.

Final instar—Similar to preceding, except that the horn is of medium length, mauve, minutely tuberculate and slightly down-curved. Dorsal line tinged with mauve. Ocellus surrounded by a dark green line above and deep purple below, the purple diffusing slightly into the cream ring. Subdorsal stripe edged above with dark green.

Brown form—Head brown, the clypeus and a narrow stripe to the vertex paler. Body pinkish brown. A dark dorsal line, almost obsolete on the abdominal somites except on the intersegmental areas. A narrow dark subdorsal stripe from 1st somite to base of horn, edged below with paler. Thoracic somites very slightly speckled with darker dorsally, the abdominal with the speckles arranged in minute checks and with a darker x-shaped dorsal mark on each somite. The ocellus on the 4th somite with the pupil white, the iris olive brown, the surrounding ring cream edged with black, shape as in the green form. Lateral area darker brown on somites 1 to 4, the same colour as the dorsum on the others and with a series of roughly triangular, oblique, dark streaks. Venter dark brown on somites 1 to 4, pale pinkish brown on the others. Legs pinkish. Prolegs dark brown. Spiracles brown. Horn purplish.

When alarmed the head and first two somites are withdrawn into the third, and the ocelli on the 4th somite protrude slightly.

Pupa in a slight cocoon of netted threads spun among dead leaves and litter. Ground colour pinkish bone very heavily suffused and speckled with black except on the dorsum of the first three abdominal somites. A broad blackish green dorsal stripe. Spiracles black. Venter less suffused with black. Proboscis sheath projecting slightly frontally and rather more ventrally. Cremaster black, short and triangular, and ending in two slightly separated points, concave below and with a deep pit running from the base forward into the 13th somite.

Food-plant—*Ampelopsis* sp., *Vitis* sp. Scott adds *Dillenia gyna* Roxb., *D. indica* L., *Hibiscus mutabilis* L., *Fuchsia*, *Amorphophallus*, and Seitz mentions *Cissus*.

Described from a larva found in Calcutta, pupated 27-vii-43 and a female emerged 10-viii-43.

Hampson's description in the *Illustrations* is as follows:—  
'Pale green, thickly speckled with darker spots and striae on

fifth to tenth somites; the fourth somite swollen, bearing a pair of large ocellated spots, green, bordered with yellow above and pink below, and with a central linear white spot; a pale lateral line with dark upper edge from anterior edge of fifth somite to root of horn; stigmata edged with pink; horn purple, stout and curved. Legs pink; claspers green. There is a variety in which the green colour is replaced by brown, with the exception of the ocellated spots, which remain olive green. In some specimens there are traces of irregular diagonal spots between the spiracles. The young larva has a long thin horn, recurved at the tip., and this, in an abridged form, is repeated in the *Fauna*. Seitz writes 'Larvae green or brown. On the 4th ring a fictitious eye with a horizontal slit pupil, behind this on each ring a blind eye below which there is a dark oblique shadow.' Scott mentions that the blind ocelli may extend from somites 5 to 10, be confined to that on 5 only, or be entirely absent.

#### LIMACODIDAE:

##### *Thosea cana* Wlk.

Moore, *Lep. Ceyl.*, ii, 129, pl. 130, fig. 3b. 1882-83.

Hamps., *Fauna Brit. Ind.*, Moths, i, 378. 1892.

Hering, *Seitz Indo-Austr. Bombyces*, x, 713. 1931.

Head green marked with brown above the mouth-parts, retractile. 1st somite green, retractile. Colour pale green with a narrow bluish white dorsal stripe. A subdorsal series of ten shortish green scoli tufted with yellow bristles and a lateral series of ten similar but larger scoli, the first scolus of each series rather shorter than the others. A series of irregular depressed marks edged with yellow between the two series of scoli. A sub-lateral yellow line. Venter yellowish. Before pupation the colour becomes duller and the dorsum develops a reddish suffusion at each end.

Cocoon of the usual hard Limacodid type, ovoid, of a dark chestnut brown colour. Empty pupa skin brownish yellow.

Food-plant—*Cassia fistula* L.

Described from a full fed larva found in Calcutta 10-viii-43, spun 14-viii-43 and a female emerged 26-ix-43.

All the published descriptions are based on that of Moore:— 'Larva onisciform, oblong, convex above, green with a pale yellowish, white dorsal band, a subdorsal row of very short spinous tubercles, and a sub-lateral row of somewhat larger tubercles; spiracles with pale rings. Cocoon oval, purple brown. Feeds on *Cassia auriculata*, etc.'

##### *Thosea tripartita* Moore.

Sevastopulo, *Journ., Bomb. Nat. Hist. Soc.*, xlv, 193. 1945.

Head brown, retractile. 1st somite green retractile. Body grass green with a bright blue, narrow, dorsal stripe, edged with darker blue and bordered by a narrow yellow stripe. A paired dorsal series of dull bluish glandular-looking specks, barely visible

without a lens. A subdorsal series of ten short, erect, green scoli tufted with greenish bristles, and a sub-lateral series of larger, outward-pointing scoli, the first scoli of each series smaller than the others. A series of irregular sunken marks outlined by a yellow line between the two series of scoli. Ventral surface paler green. When full fed the ground colour becomes bluer and the yellow dorsal stripes fade. Immediately before pupation, the ground colour turns to a golden brown slightly tinged with pink, the dorsal line pinkish.

There is considerable minor variation, one larva had a small white dorsal spot in the middle of the blue stripe on the 4th and 7th somites; another had the dorsal stripe purple with a central white line from 2nd to 4th somites, then blue with a short purple bar surrounding a white spot on the 7th and a purple-ringed white spot on the 10th somite.

Food plant—*Ricinus communis* L. (Castor).

Described from a number of full fed larvae found in Calcutta, one of which spun 31-viii-43 and a female emerged 18-ix-43.

*Altha nivea* Wlk.

Sevastopulo, *Journ. Bomb. Nat. Hist. Soc.*, xlii, 288. 1941.

Very young larvae are a translucent greyish-white with a transverse olive brown band anteriorly, centrally and posteriorly, the central band rather broader than the others. Under a lens there is a double dorsal series of six transparent, glassy humps. Later the colour becomes green, but the humps persist until the larva is more than half grown.

When small the larva feeds on the upper surface of the leaf, eating out a narrow, semi-transparent track.

Food-plant—*Ricinus communis* L. (Castor).

Described from larvae found in Calcutta in August 1943.

#### NOCTUIDAE:

*Phlegetonia delatrix* Guen.

Moore, *Lep. Ceyl.*, iii, 63, pl. 151, fig. 6a. 1884-87.

Hamps., *Fauna Brit. Ind.*, Moths, ii, 391. 1894.

Hamps., *Cat. Lep. Phal.*, xi, 83. 1912.

Gaede, *Seitz Indo-Austr. Noctuidae*, xi, 360. 1937.

Head yellow green, somewhat flattened. Body rather bluer green, the intersegmental folds yellower, a yellow subdorsal line, almost obsolete on the thoracic somites, and a faint yellow spiracular line. A pulsating dark dorsal line. Spiracles yellow. Legs and prolegs very pale green. The younger larvae with the abdominal somites suffused with purplish due to the colour of the food in the intestines. A few short colourless hairs. Shape short and stout, the posterior somites with a somewhat square appearance. Turns purplish just prior to pupation.

Pupa in a slight earth covered cocoon attached to a leaf in captivity, in the wild state probably among litter on the surface of the soil. Dark mahogany, the wing cases, leg and antenna

sheathes paler, the intersegmental areas and an indistinct dorsal line darker. Cuticle punctate. The abdomen ending in a blunt cone without any trace of cremaster or bristles.

Described from a full fed larva found in Calcutta 18-vii-43, pupated 21-vii-43 and a male emerged 31-vii-43.

Moore's description is as follows:—'Larva green, paler on the sides; with a slender subdorsal whitish line and a row of small lateral spots. Pupa red, enclosed in a slight cocoon under portions of leaves and excrement', and this appears to be the basis of the other published descriptions.

*Achaea melicerte* Drury.

Sevastopulo, *Journ., Bomb. Nat. Hist. Soc.*, xli, 319. 1939.

1st instar—Head yellow brown. Body yellow brown, becoming darkish green after feeding. Under a lens with minute black specks giving rise to short colourless hairs. A semi-looper.

2nd instar—Head brown, clypeus filled in with white, and with two white spots on each side of the vertex. Body grey, thickly coated with a white mealy powder. A lateral series of black spots, increasing in size from 3rd to 4th somites and then decreasing again to the 9th, and a dorsal series on the 4th to 7th somites. Traces of a white subdorsal line. 11th somite with a dorsal pair of black tubercles each bearing a black bristle, 12th somite with a similar but smaller pair. Legs black. Prolegs blackish, first pair obsolete, second obsolescent.

3rd instar—Similar to preceding but with much less of the mealy covering. Head with a white lateral blotch.

4th instar—Similar to preceding but without any mealy covering. Ground colour grey minutely speckled with darker. In some specimens the dorsum distinctly blacker than the rest of the body. Lateral black spots ringed with whitish. A transverse black dorsal band on the posterior edge of the 4th somite, with a series of four white spots immediately behind. Head with the ground colour black.

5th (final) instar—There is very considerable variation. In some cases the black dorsal and lateral stripes are wanting, whilst in others the black colouration is increased completely obliterating the usual brown areas, the larva appearing to be black with a whitish subdorsal line, a yellowish supra—and a reddish subspiracular one. In these examples the ground colour of the head is black, the transverse black band on the 4th somite invisible but the spots behind very noticeable. Some of the unicolorous, pale specimens lacked the cream coloured lateral patch on the head.

Food-plant—I have also found this larva on cultivated Roses. Described from larvae bred in Calcutta in October 1943.

GEOMETRIDAE:

*Ptochophyle togata* F.

Pupating larva—Head green, bifid. Body green, the abdominal somites with a dorsal stripe composed of small purple blotches.

Pupa formed in the trough of a leaf, the edges pulled together slightly by a few strands of white silk, attached by the cremaster and a girdle to a slight carpet of white silk. Colour frosted green, the head and prothorax truncate and olive brown in colour. Cremaster purple brown. The end of the abdomen just anterior to the cremaster is angled so that the pupa stands at an angle of about  $45^\circ$  from the vertical.

Described from a pupating larva found in Calcutta 28-viii-43. Pupated 28-viii-43 and a female emerged 1-ix-43.

#### PYRALIDAE:

##### *Zinckenia perspectalis* Hbn.

Head brownish black, very shiny. 1st somite with a shiny, brownish black dorsal plate, divided in the middle by a white stripe. Body green, paler below the spiracles. A pulsating dark dorsal line, a pale spiracular line. A few single colourless hairs. Legs and prolegs almost colourless. Turns red before pupation.

Pupa in a silk-lined cell formed by biting through a leaf of the food-plant almost to the centre vein and joining the two flaps thus formed together. Pale chestnut brown, not very slender, the leg and proboscis sheathes not extending beyond the wing cases. Male pupa with a small projection behind the eye, containing the tooth on the antenna.

Food-plant—Garden Balsam. The larva spins the leaves at the tip of a shoot together and lives and feeds within.

Described from a full fed larva found in Calcutta 26-viii-43, pupated 29-viii-43 and a male emerged 5-ix-43.

##### *Phryganodes analis* Snell.

Head very pale ivory white, the mandibles blackish and with a fine blackish line above the antennae. Body with the thoracic somites very pale buff, the abdominal bluish white, the colour due mainly to the contents of the intestines. A pulsating dark dorsal line. Legs old ivory. Prolegs bluish white. Spiracles white. Somites rather deeply divided, thoracic somites somewhat flattened. A few, fairly long colourless hairs. Turns pink before pupation.

Pupa in a folded leaf lined with white silk. Reddish brown, slender. The cremaster fairly long and fixed in the silk lining of the leaf.

Food-plant—*Cassia fistula* L., spinning two leaves together and living and feeding between.

Described from a full fed larva found in Calcutta 28-vii-43, pupated 31-vii-43 and a male emerged 8-viii-43.

##### *Lepyrododes neptis* Cr.

Head yellow green with a blackish lateral line. Body jade green, rather more opaque than most Pyralid larvae, with a darker dorsal stripe. 1st somite with a very minute black subdorsal dot, 2nd somite with a slightly larger dot. A few short colourless hairs. Lives in silk-lined, spun-together leaf.

Pupa in a spun-together leaf. Emerald green with a darker



dorsal abdominal line. Very long and slender, the head produced to a snout, the body widest just before the middle of the thorax and then tapering towards the cremaster. Legs and antenna cases very long and extending almost to the end of the abdomen. Cremaster a black triangular point armed with short hooked spines.

Food-plant—Jasmine.

Described from a full fed larva found in Calcutta 3-x-43, pupated 5-x-43 and a male emerged 10-x-43.

*Leucinodes orbonalis* Guen.

Cotes *Indian Museum Notes*, iii, 100.

Lefroy, *Indian Insect Life*, 518. 1909.

Head chestnut brown. 1st somite with a brown dorsal plate. Body pinkish brown with a darker dorsal line. Anal plate blackish brown. 2nd and 3rd somites with a transverse series of six olive green warts bearing colourless bristles. Abdominal somites with a subdorsal, suora- and sub-spiracular series of similar, but smaller, warts, all of which are only visible under a lens. Venter and prolegs very pale pinkish brown. Legs blackish. Spiracles blackish. Turns pink before pupation.

Pupa in a flat cocoon of pinkish, parchment-like silk spun between leaves, in nature probably among dead leaves on the ground. Stoutish, the dorsum of the abdominal somites deep pink, the venter pale yellow, thorax and wing cases brownish yellow. Leg and proboscis sheathes extending slightly beyond the edge of the wing cases. Cremaster short, spade-shaped and fringed with very fine hooked spines.

Food-plant—Various species of Solanaceae, feeding in the fruits.

Described from a full fed larva found in Calcutta 15-x-43, spun 17-x-43 and a female emerged 23-x-43.

Lefroy describes the larva as being pink, smooth and almost hairless, boring in the fruit of wild and cultivated Brinjal.

*Pyrausta incoloralis* Guen.

Head yellowish green, bearing a few colourless bristles. Body rather bluer green, chiefly due to the contents of the intestines. A white spiracular line. 2nd somite with a minute black subdorsal speck. A few colourless hairs. Legs and prolegs pale glassy green. The larva lives under a web spun on the underside of a leaf of the food-plant and is extremely difficult to detect as the colour of the silk is an exact match of the silver-grey colour of the leaf.

Pupa in a cocoon of fairly dense white silk spun in a turned over leaf. Very pale green, the abdominal somites tinged with whitish. A very fine transverse brown line dorsally on the posterior edge of the 1st, 2nd and 3rd abdominal somites. Leg and proboscis sheathes slightly longer than the wing cases. Cuticle of abdomen very minutely punctate.

Food-plant—*Calotropis procera* Br.

Described from a full fed larva found in Calcutta 12-xi-43, pupated 16-xi-43 and a female emerged 24-xi-43.

(To be continued.)



SOME OBSERVATIONS ON SOUTH INDIAN  
COMMELINAS; TWO NEW SPECIES OF COMMELINA  
FROM SOUTH INDIA.\*

BY

EDWARD BARNES

(With two plates)

It is well-known that in the genus *Commelina* the spathe usually contains two cymes, that the flowers of each cyme open one at a time and remain open only for a few hours, and that the flowers of the inner cyme are often infertile. Very little further information about the flowering of these plants appears to be available. The writer has made observations on the sequence of flowering in a number of South Indian species, the details of which are recorded below under each species. It is found that each species has a more or less characteristic behaviour, the average interval between the opening of successive flowers, and the variation of this interval, differing in different species. This behaviour is no doubt affected by temperature, humidity, fertility of soil and other external factors, but it appears to be largely characteristic of the species, as most species will grow and flower only between certain limits of warmth and moisture.

An interesting fact noticed during these observations is that the development of the pistil in a flower of the outer cyme depends on whether or not the previous flowers of that cyme have been fertilised and are forming capsules. Usually the first few flowers on the outer cyme have completely developed and fertile pistils. After one or more capsules have been set, subsequent flowers have pistils aborted to various degrees. The stages of abortion are usually—shortened style, further shortened style which remains coiled, small ovary and almost no style, vestigial ovary. In all flowers the stamens are fully developed and fertile. If, however, each flower is removed after opening, or even if the partially

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\*Except for a few very minor details, the ms. of this article was complete at the time of my husband's death. Owing to the difficulty of correspondence with Britain during the War, he was unable to send specimens of the two new species to Kew Herbarium for examination and report, and he planned to consult specialists in India before publishing the descriptions. This he was prevented from doing by illness and death. He had, however, named both species, and written the Latin diagnosis for *C. indehiscens*. Thanks are due to Mr K. Cherian Jacob of the Government Agricultural College, Coimbatore, and Dr S. K. Mukerjee, Curator of the Herbarium of the Royal Botanic Garden, Calcutta, for their kindness in scrutinising specimens and studying the written descriptions. They have confirmed my husband's opinion that both *Commelina indehiscens* and *Commelina tricolor* are new and distinct species. Dr Mukerjee kindly supplied the Latin diagnosis for *C. tricolor*.

developed capsule or capsules are removed from the cyme, the subsequently opening flowers develop fertile pistils. On the other hand, the removal of the whole outer cyme from a spathe while in bud does not appear to induce the infertile flowers of the inner cyme of that spathe to develop pistils, although vestigial pistils may be present, and although perfect flowers producing capsules may very occasionally occur on the inner cyme in that species.

In identifying the plants used, it was found that both the published descriptions and the reference herbarium material are often incomplete. This is especially the case as regards the flower. The petals are very delicate, soon shrivel and stick to the pressing paper; the filaments and style although slender are succulent, and they coil together and lose most of their characteristics on drying. Consequently very few herbarium specimens have flowers of which the details can be made out. As the original descriptions of a number of species were made from herbarium material, the details of the flowers appear never to have been recorded in these cases. It therefore appeared to be desirable to give a description of the living flower, especially as the flower does not appear to vary much in the different forms of the same species, and as there are sometimes characteristic features or combinations of features useful in identification.

In this genus identification is frequently difficult. Not only are the flowers often undescribed or inadequately described, but the leaf and stem are often very variable, and in most species there are a number of forms or varieties differing in habit, hairiness and other characters. Classification is based largely on the characters of the spathe, capsule and seed. But unfortunately, in spite of free flowering, it is often remarkably difficult to find ripe capsules and seeds of the plants in the wild state. Probably birds or field mice search systematically for the maturing capsules. This may account for the fact that many herbarium specimens are without mature capsules and seeds, and it is not surprising that much confusion exists as to their identity. In order to establish the identity of the plants referred to, and because the details, if recorded, are not easily available, descriptions of the spathe, capsule and seed have also been given in this article for each species.

#### *Method of Observation:*

The method of observing the sequence of flowering was very simple. A small numbered ticket was attached to each spathe when it first flowered, and each morning it was recorded which marked spathes had flowers; the state of development of the pistil in each flower was also noted. As far as possible observations were made on plants growing in their native habitat. It was found, however, that such plants suffer many casualties. The flowers and spathes are attacked by many insects, and the plants being succulent are sought for by browsing animals. Consequently with unprotected plants only a small proportion of marked spathes usually survives for complete observation. Where observation could not be made in the field, the plants were planted in pots and kept in

the writer's garden, but observation was not begun for some weeks or months so that the plants should have become acclimatised to their new situation.

#### *A Method of Preserving the Flowers:*

As it is very desirable that herbarium material should include well-preserved flowers, the following simple method of collection and treatment is given. The flowers are usually open only in the morning and shrivel soon after collection. They should therefore be pressed on the field. A small easily portable press about 10 x 6 ins. made of 3-ply wood and with three butterfly screws, and containing sufficient absorbent paper, is convenient. An envelope containing pieces of good quality white tissue paper about 2 ins. square and folded double should be kept in the press. In addition to complete specimens of the plant, several flowering spathes should be gathered. The spathe should be opened out and any mucilage absorbed and then the flower and open spathe should be carefully pressed between a folded tissue paper. The pressing paper should be changed without opening the tissue papers till the flowers and spathes are quite dry. Then a quantity of Canada balsam diluted with toluene or xylene is applied to both sides of each folded tissue paper which is then pressed between two microscope slides so as to expel air bubbles and excess of balsam. The slides are then dried in a warm place. If the tissue paper is of good quality, it becomes almost completely transparent in Canada balsam, and the details of the flower can be clearly seen even with a lens. The colour of the petals is not affected by long exposure to light if preserved in this way. Instead of using glass slides, a patch of Canada balsam may be applied to each side of the folded tissue paper over the flower. After drying for some days, these papers may be mounted on the sheets with the rest of the plant. The result without glass is not however very permanent as after some months or years the Canada balsam turns brown and the colour of the petals fades.

Some observations have also been made on self-fertilisation by the coiling together of the stamens and style. In some species this coiling is highly developed and is very successful in ensuring fertilisation, while in others it is quite ineffectual. The style and the anthers of the lateral stamens are coiled in the bud, and the coiling in the latter stages of flowering is apparently a reversal of the process of expansion. Only in some species has this movement been elaborated and adapted to self-fertilisation. The fact that coiling of the anthers occurs in male flowers as well as in perfect ones suggests that the action is purely mechanical.

In some species the spathe contains mucilage in which the flower buds remain immersed. The purpose of this mucilage appears to be to prevent the buds from being attacked by aphides and other small insects. The buds of species that do not produce mucilage, such as *C. clavata* and *C. indehiscens*, are often much attacked by aphides which are placed in the spathes by small ants.

Some brief notes about distribution, forms and habits are given. It is remarkable that even the colour of some common species does

not appear to have been correctly recorded. Some species have several different forms differing in leaf, size and shape and in habit. Some of these forms appear to be sufficiently distinct to be given the status of varieties, but much more complete collections and many more field observations appear to be necessary before this can be usefully undertaken.

***Commelina nudiflora* Linn.**

*Flower and Spathe.*

Spathe rather variable in shape, ovate-cordate, tapering to an acute or acuminate tip, the two halves folded together, or oblong-lanceolate, the two halves folded together at the base but the upper portion flat and ligulate with a more or less rounded tip, up to 3.5 cms. long and 1.5 cms. broad (opened out), glabrous, without mucilage; peduncle slender, from about half as long as the spathe to much longer, sometimes slightly hairy at the upper end; solitary, leaf-opposed. Inner cyme branch nearly twice as long as the outer.

Two anterior sepals broadly ovate, concave, joined together at the base for about  $\frac{1}{3}$  their length, white or tinged blue, with 2 or 3 obscure greenish nerves, tips rounded; posterior sepal broadly boat-shaped, with 3 or more prominent green nerves, tip incurved. Two posterior petals cordate-reniform, unequal-sided, .6-.7 cm. dia. claws narrow, at about right angles; anterior petal a little smaller, cordate, concave, margin irregular, tip rounded or bluntly triangular, claw very short; all usually deep blue, sometimes paler. Two lateral stamens with long blue filaments and small anthers with blackish margins; median stamen with shorter filament, another larger, deep yellow, the cells curved and diverging at the base, connective between the cells white or blackish. Pollen grains yellow, narrowly ovoid, with a longitudinal groove, surface smooth, minutely pitted, rather variable in size, .04-.05 x .02-.03 mm. Staminodes more often 2 than 3; filaments slender, blue, about half as long as those of the lateral stamens heads yellow with two long large lobes and usually several small round ones; third staminode when present often without a head. Ovary ovoid narrowed to the style, papillose, pale green: style about as long as the longer stamens blue curved forward.

*Sequence of Flowering.*

There are normally two cyme branches in the spathe. The inner bears usually one but sometimes up to 3 flower buds. With very few exceptions the first two of these on opening are found to be male; the third does not mature. Of the 3 or 4 flower buds on the outer cyme branch the flower developing from the first is almost always perfect, but only a small percentage of second and third flowers have fully developed pistils, and the fourth rarely opens. Plants from Chembarambakkam and from the Unamalai Hills, both in the Chingleput District, were grown at Tambaram and 123 spathes were marked between December and April. Of these on first flowering, 99 had a perfect flower on the outer branch only; in 15 there were both a male on the inner and a perfect flower on the outer branch; 6 had a male on the inner branch only; 2 had perfect flowers on both cymes, and one had an imperfect flower on the outer cyme branch. Of those that first produced a perfect flower on the outer branch, 37 next had a male flower on the inner branch (25 next day, 7 after an interval of 1 day, 5 after 2 days, 3 after 3 days, 1 after 5 days). Of the 15 that first opened flowers on both branches, 3 next opened a second male on the inner branch (after 2 days), and 2 produced an imperfect flower on the outer branch (after 1 and 2 days). Two of the spathes that first had a male on the inner branch next opened a perfect flower on the outer branch (after 1 and 2 days), and one had an imperfect flower on the outer branch (after 1 day). The 2 spathes that had a perfect flower on each cyme produced an imperfect flower on the outer cyme after one day, and one of these opened a second perfect flower on the inner branch on the following day. Of the other spathes that were in flower on a third occasion, 14 had perfect and 17 had incomplete flowers on the outer branch; 2 had second male flowers on the inner branch, and one had a male on the inner and a perfect flower on the outer. Very few spathes produced a further flower, and these were mostly incomplete ones on the outer branch.

Plants from Palmaner (Chittoor District) grown at Tambaram behaved similarly. Of 10 spathes, 7 produced first a perfect flower on the outer branch, followed in 3 cases by a male on the inner next day or after an interval of one day; 3 had a male on the inner and a perfect flower on the outer branch on first flowering, followed after an interval of a day by a second perfect or imperfect flower on the outer branch.

Plants from Trivandrum also behaved in a similar manner except that more frequently two flowers opened on the inner cyme branch with intervals of 1 to 3 days.

As in the case of *C. kurzii*, the removal of a perfect flower has the effect of causing the next flower to become perfect. The perfect flowers on the outer branches of 7 spathes were cut off. In each case the second flower was perfect. These were removed and the third flower was also perfect. From 6 spathes the capsule which had developed on the outer branch of the cyme was removed. In five cases the next flower on this branch was perfect, and in the other the flower had an imperfect pistil. Occasionally a flower on the inner cyme branch is perfect and a capsule may be formed. It was thought that by completely removing the outer cyme branch some days before a flower opened, the flower or flowers of the inner cyme might become perfect. However, after removing the outer branch of the cyme while in bud from 6 spathes, it was found in each case that the flower that later opened on the inner cyme branch was male.

#### Self-fertilisation.

The filaments of the lateral stamens coil strongly and the filament of the median stamen also coils at its upper end. The style bends so that the stigma usually comes in contact with the anthers. The staminodes do not usually coil. An examination of numerous spathes with capsules showed that in most cases a capsule was formed from the first flower of the outer branch. This suggests that self-fertilisation is usually effective.

#### Capsule and Seed.

Capsule ovoid-oblong, slightly constricted at the middle, buff-coloured, surface smooth or very finely furrowed, tip shortly cuspidate, 3-celled, 2-valved, 2-cells, 2-seeded, posticous cell 1-seeded and indehiscent. After dehiscence both valves remain attached to the pedicel. The peduncle becomes more or less deflexed before the capsules dehisce, and so the seeds of the two antieous cells usually fall out. Some time after dehiscence the peduncle becomes detached from the plant, and the brown and shrivelled spathe containing the 1-seeded indehiscent cell of the capsule falls to the ground and is likely to be blown to some distance by the wind. Not infrequently two capsules mature on the outer cyme branch. Very rarely there may be a capsule on the inner branch.

Seeds ovoid, truncate at one end, 2.5-3 mm. long, greyish-black, cindery, surface coarsely reticulate and with finer reticulations in the pits, one face flattened and with a longitudinal ridge (hilum), one edge with an obscure round pit with a blunt process at the centre (micropyle).

From flowering to dehiscence of capsule averages about 18 days, variation 16 to 21 days.

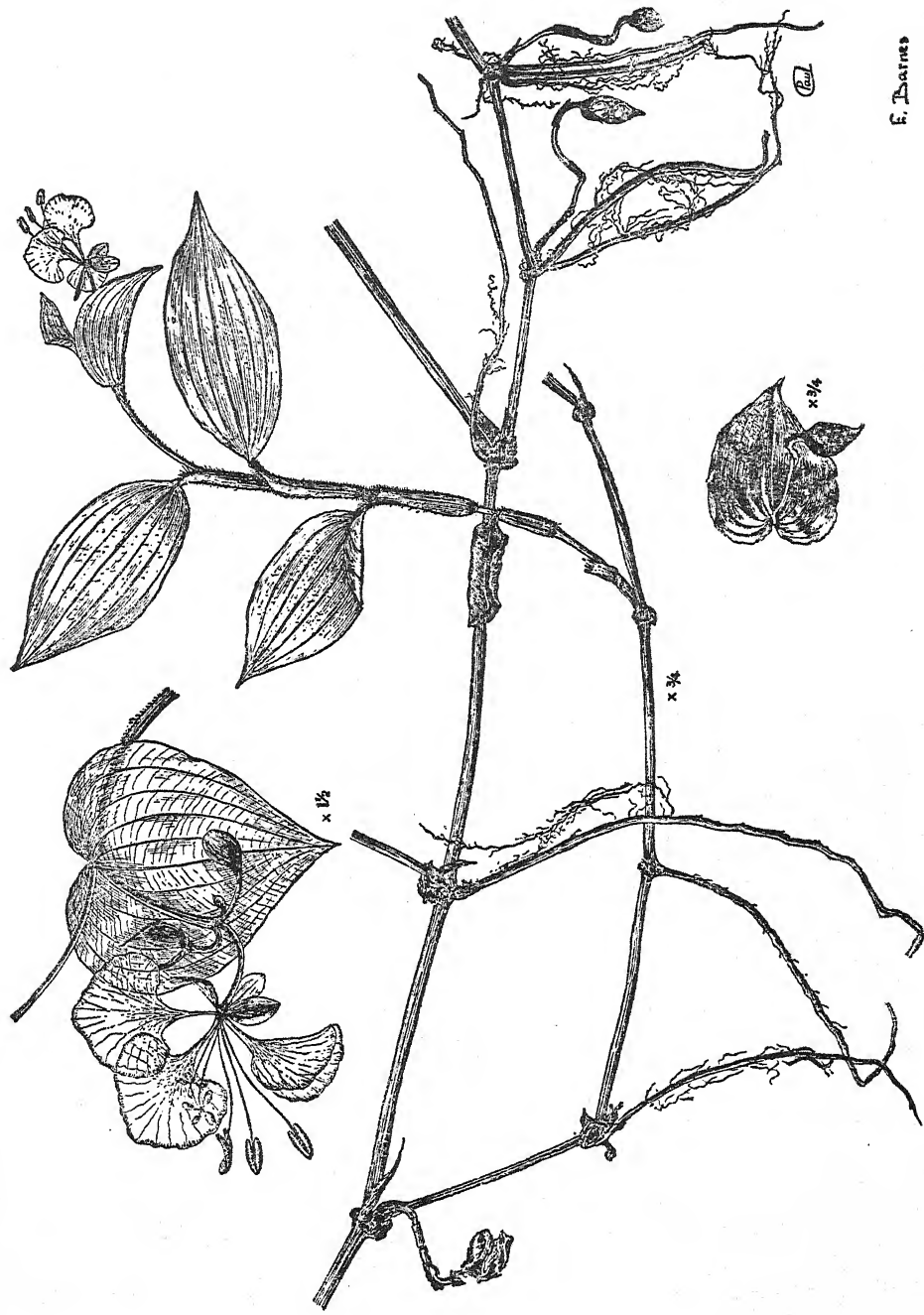
#### Distribution.

This plant is common on the margins of ponds and in other wet places on the plains and up to the Mysore Plateau (Chingleput, Nellore, Chittoor, Trivandrum). It roots very freely at the nodes, the roots often being 6 inches long or more before reaching the ground. The roots are fibrous. The plant is an annual but is able to persist if conditions remain moist.

#### *Commelina indehiscens* E. Barnes sp. nov.

*C. nudiflorae* Linn. affinis, sed major, capsula 1-sperma indehiscens, floribus cleistogamis, capsulis subterraneis differt.

A much branched extensively-running prostrate, probably perennial herb. Roots long and fibrous. Stems round, up to about .6 cm. in diameter, glabrous, green, often with red longitudinal striations. Leaves ovate to broadly lanceolate, slightly unequal-sided, up to 13 cms. long and 3.5 cms. broad, usually smaller, apex acute or acuminate, base rounded and then narrowed to a petiole up to



*Commelina indehiscens* Barnes Sp. Nov.



F. Barnes

*Commelina tricolor* Barnes Sp. Nov.

about 1 cm. long, with short stiff somewhat bulbous-based hairs on both surfaces, sometimes almost glabrous, margin minutely serrate; sheaths up to 2.5 cms. long, strigose, mouth ciliate, often lax and striated and mottled with red. Spathes broadly cordate, apex acute, the two halves folded together, usually about 2 cms. long and broad (opened out), sometimes larger, outer surface somewhat strigose; peduncles up to 3 cms. long, strigose, leaf-opposed. Posterior sepal boat-shaped, apex narrowed and concave; anterior sepals ovate-orbicular, concave, fused together for about  $\frac{1}{3}$  of their length, colourless and transparent. Posterior petals with broadly reniform or deltoid lobes, up to about .9 cm. diameter, claws slender, at about right angles to one another; anterior petal a little smaller, sometimes with a blunt triangular apex, claw short; all bright blue. Staminodes 3 or 2; filaments slender, about as long as the median stamen; heads yellow, with 2 larger and 2 smaller lobes on narrow stipes, often wanting in the posterior staminode. Lateral stamens with long, slender more or less straight filaments; anthers small, yellow margined with bluish-grey, cleft at the base; median stamen with shorter filament and larger anther the cells of which diverge at the base. Pollen grains ovoid-oblong, slightly curved, .07-.09 x .04 mm., surface finely and densely spinulose. Ovary slightly papillose tapering to the style, 2 cells 2-ovuled, 1 cell 1-ovuled; style a little longer than the stamens, curved forward. Capsule indehiscent, 3-celled, 2 antipodal cells linear, empty, posticous cell gibbous, keeled, 1-seeded, apex acuminate, sometimes curved, surface light brown, finely wrinkled. Seed (after removing the adhering cell-wall) ovoid, .5 cm. long, black, surface reticulately pitted, the ridges forming the reticulations brown, irregular and with short lateral branches, a round pit with a central point on one side (micropyle).

#### *Sequence of Flowering.*

Plants from the Billigirirangan Hills were grown at Tambaram and 28 spathes were marked (Feb. and March). Their flowering was found to be much more irregular than any other species examined. Six of these spathes had a small leaf in place of the inner cyme, and 13 others had no inner cyme, or it did not mature any flowers. The remaining 9 spathes had together 18 flowers on the inner cyme; 13 of these were male or had an incompletely developed pistil, and 5 were perfect, three being on the same cyme. On the outer cyme branch, 7 spathes first produced one or more perfect flowers to be followed by flowers with pistils aborted to various degrees. Successive flowers followed on the next day in 7 cases, after an interval of 1 day in 11 cases, and after an interval of 2 days in 5 cases. As judged by other species, this may be regarded as the probable normal behaviour. Seven other spathes, however, behaved in the opposite manner, producing first one or more male or imperfect flowers and then producing perfect flowers. Three spathes produced only imperfect flowers on the outer cyme. Nine others produced only perfect flowers on the outer branch, several having as many as 7 opening on successive days, or after an interval of 1 day. No capsule was formed in these nine spathes, as self-fertilisation does not occur in this species.

#### *Self-fertilisation.*

The lateral stamens coil only after the petals have begun to wilt. The staminodes do not coil and the median stamen does not appear to coil although it becomes curved inwards as a result of the shrivelling of the petals. The style does not coil but remains erect when the flower has completely shrivelled. Self-fertilisation therefore does not usually occur. The small percentage of capsules set by perfect flowers when the plants are grown where they are not visited by the insects of their native habitat, confirms this (see above). The same plants when pollen was transferred by a brush, produced capsules readily.

#### *Underground Capsules.*

On examining the root system it was found that at a number of nodes, in addition to several roots, slender underground stems bearing capsules have their origin. These underground stems are white, having usually 4-6 nodes, each with a scarious ovate acute leaf about .5 cm. long or less. A small root usually emerges from the node just above the capsule. The capsules are similar to the normal capsules but are stouter and with less acute tips; they



also contain a single seed in the posticous cell. The seed is .6 cm. long with the surface very obscurely reticulate. These capsules originate from underground cleistogamous flowers.

No underground cleistogamous flowers were found, but several flowers intermediate between normal and cleistogamous ones were seen. These are formed when the node bearing a slender lateral branch that would normally produce a cleistogamous flower is not in contact with the ground owing to a rock or other obstacle, and so the lateral branch is not able to penetrate the soil. Such branchlets are strongly geotropic and run vertically from the node towards the ground. They bear at their ends a very small green spathe containing one or two reduced cymes. Each of the spathes seen had a flower on the outer branch. These flowers had 3 blue petals more or less equal in size but much smaller than in normal flowers. They had well developed pistils but with short styles; and three staminodes. One had all three stamens fertile; in one the lateral stamens only had a little pollen; and the other had all three anthers infertile. The flowers were facing the ground and one was face downwards on the ground.

#### Occurrence.

This plant occurs in swamps and on the margins of streams in wet evergreen forest on the Billigirirangan Hills, Mysore, at about 4,000 ft.—Minchiguli Valley, and near Bedaguli. It flowers in June when the underground capsules are also present. Plants seen in September had neither flower nor underground capsules. It was also found to be common in the Oucherlony Valley, Western Nilgiris, along streams at about 3,000 ft., and in the Nilgiri Wynad about a mile west of Nadgani, flowering and with underground capsules in August. It was also found at Palaar, Travancore High Range, Fl. May Nos. 1527, 1776, 2135-7, 2163-5, 2296.

The spathe, after a capsule has formed and the flowering is over, becomes deflexed so that the open edge rests on the ground.

A stem that was measured was 7.35 metres long and was still growing. It had rooted at most nodes and at 24 of these nodes there were semi-erect leafy branches up to 25 cms. long. The same plant had a number of other main stems several metres long, running in other directions. About half the flowers seen had only 2 staminodes.

This plant is probably common in evergreen forest at 3-4,000 ft. It superficially resembles *C. clavata* (Clarke), and has probably often been mistaken for it. The indehiscent capsule is a unique character, and the combination—complicate, not funnel-shaped, spathe and cleistogamous flowers—distinguishes this plant from other South Indian species.

#### *Commelina hirsuta* Clarke.

##### *Spathe and Flower.*

Spathe solitary, leaf-opposed, lanceolate or ovate-lanceolate, 1.8 to 4.0 cms. long, 1.0 to 1.5 cms. broad (opened out), the two halves folded together, base rounded or somewhat cordate, apex acuminate, margin dark red, with stiff white slightly bulbous-based hairs along the basal half or throughout, outer surface sub-glossy, with very short hairs, mucilage absent or scanty. Peduncles slender, up to 7.5 cms. long, hirsute, often reddish. Inner cyme branch usually barren and only a few mm. long, hairy, tip pointed, rarely bearing a single flower with an undeveloped pistil; outer cyme branch 3-to 5-flowered, broad, channelled on the inner side, hairy, often with a very narrow collar-like bract below the pedicels; pedicels hairy. Posterior sepal broadly boat-shaped, with 3 broad green veins, margin colourless; anterior sepals obovate-oblong, fused together near the base, concave, colourless with 1 or 2 diffuse veins. Posterior petals orbicular unequal-sided at the base, up to 1.3 cms. dia., margin irregularly crenate sometimes shallowly toothed, claws rather short; anterior petal a little smaller, cordate, apex bluntly triangular, claw short; all petals deep turquoise blue. Two lateral stamens with rather thick, nearly straight, blue filaments and large yellow anthers, the cells separated at the base; median stamen similar but filament about  $\frac{2}{3}$  as long and anther cells diverging below. Three staminodes with slender filaments  $\frac{1}{3}$  to  $\frac{1}{2}$  as long as those of the

lateral stamens, heads small and variable in shape, usually with an irregularly roundish on pear-shaped lobe or two-lobed, white, blue or purple. Ovary tomentose; style about as long as the lateral stamen, more or less straight and erect; tip turned back, blue.

The small staminodes with irregular heads, and the dark turquoise blue petals are characteristic.

#### *Sequence of Flowering.*

There is a longer interval between the opening of successive flowers of the same spathe in this species than in any other studied. For 37 cases of plants growing on the Nilgiris at 6,500 ft. and flowering in June to August the average interval was 5.2 days. The periods were:—3 cases 3 days, 7-4 days, 11-5 days, 13-6 days 3-7 days. The first flower on the outer branch is perfect and subsequent flowers are perfect till a capsule is formed, after which some flowers have an undeveloped pistil with short white coiled style, but most are perfect. The last one or two buds on the cyme do not usually develop.

#### *Self-fertilisation.*

Only the filaments of the lateral stamens coil and these complete only about one coil. Neither the style, the staminodes nor the median stamen coil before the petals shrivel. As the style is erect and its tip turned away from the stamens the motion of the anthers of the lateral stamens on coiling does not bring them near the stigma, and so self-fertilisation is not brought about by these movements. The petals on shrivelling close over the stamens and style, and it is possible that occasionally the stigma may thus be bent down to the coiled stamens. On wet days the shrivelling of the petals may not occur till nightfall. Observations show that only a very small percentage of flowers form a capsule, more than one capsule being found in a spathe only very rarely, and often there is none.

#### *Capsule and Seed.*

Capsule 4.5 mm. long; anticus half ovoid-oblong, flat, green, hairy, with a slightly narrowed tip; posticus half broadly semi-ovoid, glabrous, yellowish, slightly keeled and wrinkled; 2-valved, 3-celled, posticus cell one-seeded, the other two cells empty or with an undeveloped seed. Seed ovoid flattened on one side about 4 mm. long and covered by the firmly adhering cell wall.

#### *Occurrence and Habit.*

This is a characteristic plant of the high grasslands (6,500 ft. and above); in wet regions, as on Gudalurmalai, Nilgiris, it occurs down to 6,000 feet or a little lower. F.M.P. gives 'Flowers yellow drying deep blue,' which is apparently taken from F.B.I. Fyson gives 'Flowers blue, yellow on the plains'. All flowers seen by the writer were intensely blue. When growing among short grass it becomes tufted, probably owing to grazing; in thickets and tall grass its stems are long and straggling. Occasionally glabrous plants are found. At lower nodes there is a cataphyll between the peduncle and the stem and clasping the stem.

#### *Commelina clavata* Clarke.

##### *Spathe and Flower.*

Spathes ovate-cordate, acuminate, the two halves folded together but usually somewhat apart towards the tip, without mucilage, usually about 3 cms. long and 2 cms. broad (opened out), margin ciliate near the base, inner surface glossy, outer with scattered short stiff hairs; peduncle solitary, leaf-opposed, usually as long as or longer than the spathe, with stiff downward-pointing hairs denser near upper end. Cyme branches 2; inner about twice as long as outer, usually 1- or 2-flowered, sometimes 3-flowered; outer usually 4-flowered occasionally with 5 or 6. Two anterior sepals broadly ovate, concave whitish or flushed blue, joined only near the base; posterior sepal broadly boat-shaped, white, with 3 green nerves. Two posterior petals orbicular-reniform, about 1 cm. dia., with narrow straight claws standing at about 60° to each other; anterior reniform, a little smaller, with a short broad claw,

sometimes with a blunt triangular apex obscurely toothed margin; all bright blue. Three posterior stamens modified to staminodes; filaments slender, about  $\frac{2}{3}$  as long as those of longer stamens, blue; heads with 4 rounded yellow lobes with thick dark brownish-red attachments, sometimes 2 smaller lobes also present. Two lateral stamens with long curved mauve filaments and small dark purple anthers; median stamen with a shorter filament and a larger anther the cells of which are curved and diverge below. Ovary finely tubercled, greenish; style sigmoidly curved so that the stigma stands out in front of the stamens, as long as the longer stamens, blue.

The dark red or brownish attachments of the lobes of the staminodes appear to be characteristic.

#### *Sequence of Flowering.*

The flowers on the inner cyme usually have only a vestigial ovary with no style and fall off after flowering, but occasionally the pistil is fully developed and a capsule may be found. On the outer cyme the first flowers to open have fully developed pistils but subsequent ones have ovaries with variously reduced styles and the last often has only a vestigial ovary with little or no style. Sixteen spathes of plants growing on the Billigirirangan Hills at 5,000 ft. in May were marked. On the first day of flowering 9 had a perfect flower on the outer cyme branch and a male flower on the inner branch, 6 had a perfect flower on the outer branch only, and 1 had a male on the inner branch only. Throughout their flowering 3 spathes matured no flower on the inner branch, 8 produced only 1, 4 produced 2 and 1 had 3. All these flowers were male (vestigial ovary). There was always an interval of at least one day without a flower between the opening of successive flowers on the inner branch, sometimes the interval was 2 or 3 days. On the outer cyme branch the first flower was always perfect. After an interval of one day a second perfect flower opened. Some spathes produced four perfect flowers with intervals of one or two days between successive flowers. More usually after two complete flowers had been produced subsequent flowers had pistils with short styles, or mere vestigial pistils. In a few cases there were intervals of three or four days between successive flowers. Up to three capsules may mature on the outer branch. From flowering to shedding of seed varied between 22 and 28 days.

Some observations were made on plants growing at Kalhatti, Nilgiris (6,500 ft.) and flowering in June. In each case there was first a perfect flower on the outer cyme branch. On the same day, the next day or after an interval of one day, there was a flower on the inner branch. In a number of cases this was perfect, but more often it had an undeveloped pistil. Several successive perfect flowers were then opened on the outer branch, the average interval between successive flowers being 3 days. A capsule was matured on the inner cyme branch in several cases. It is seen that at higher elevations the interval between successive flowers is a little greater. This is probably a temperature effect.

#### *Self-fertilisation.*

In this species the filaments of all three stamens and the style coil. The filaments of the staminodes bend and they become involved with the coiling together of the stamens and style, but they do not usually coil. The petals in shrivelling close over the contorted stamens and style. The coiling usually begins about midday.

#### *Capsule and Seed.*

Capsule oblong, tip cuspidate, glabrous, straw-coloured, 2-celled, 2-valved, one valve deciduous, both cells 2-seeded. Seeds ovoid-oblong, slightly compressed, about 3 mm. long, dull brownish-black, reticulately pitted and with finer reticulations in the pits, with a ridge along one flattened face (hilum); and a round pit with a central point on the edge (micropyle).

#### *Occurrence and habit.*

F.M.P. gives for this species 'In all districts; sea-level to 7,000 ft. Flowers lilac.' The writer has found it to be the common commelina of the hills at 4-7,000 ft.—Kotagiri, Ootacamund Downs, Kalhatti (Nilgiris), Atikan, Dupa-

barri (Biligirirangan Hills), Palaar, Karankulam (Travancore High Shevaroyes). Plants collected in Coorg and the Bababudans also appear to be this species. It has not been found on the plains of the East Coast Districts. It is similar to *C. nudiflora* which is common on the plains, and without mature capsules the two plants may easily be mistaken for one another. The flowers of all specimens seen were definitely blue.

Plants from different localities and situations vary in leaf shape from linear-lanceolate to narrowly ovate and there is also a considerable variation in hairiness, in length of peduncle and pedicel, in breadth of spathe, in number of flowers on the outer cyme and in the development of the ovary of the flowers of the inner cyme, but there do not appear to be very distinct forms.

In an abnormal plant growing at Kalhatti the spathe was large and leaflike and there was a second spathe below the flowers of the inner cyme branch. This suggests that the peduncle and the inner cyme branch are in origin parts of a scape, the spathe being a bract. This may indicate that the genus *Commelina* evolved from *Aneilema* or some other genus in which there is a cymose inflorescence with foliaceous bracts.

The roots in this species are very slenderly tuberous, clothed with a felt of old root hairs, and the bases of the stems are thickened as in *C. kurzii*, but much less so. No starch was present when the root was examined.

***Commelina tricolor*** E. Barnes sp. nov.

*C. persicariaefoliae* (Wight) affinis sed foliis minoribus angustatis sessilibus utrinque coriaceis, spathe acuminata, petalis magnis differt.

A tufted or straggling herb, probably perennial. Roots slenderly tuberous; tubers up to 5 cms. long, tapering at both ends, about .65 cm. diameter at the middle, white and pubescent when young, dark chocolate-brown when mature. Stems freely branching, up to 50 cms. long, rather slender, 2.5-3.0 mm. dia., cylindrical, slightly flattened on one side, pubescent on the flattened side, otherwise glabrous, darkish red, finely striated with green lines or spots, thickened at the base and forming a clump. Leaves narrowly oblong-lanceolate, up to 1.3 cms. wide and 7.5 cms. long, tapering to a rather blunt tip, base semi-amplexicaul, margin white or red and very finely toothed, upper surface glabrous and with very minute scattered hairs, under surface paler, glabrous, midrib depressed above, raised below, 2 or 3 pairs of more prominent nerves, often 2 on one side and 3 on the other; sheath up to 1.2 cms. long, darkish red, striated or mottled green, glabrous except for a line of pubescence down the side opposite the blade, mouth ciliate, eventually splitting along the line of pubescence. Peduncles solitary, leaf-opposed, rather stout, red or green, glabrous except for a line of pubescence often present along the inner side, up to 5 cms. long. Spathe cordate, tapering to an acute tip, up to 3.8 cms. long and 2.5 cms. wide (opened out), the two halves folded together, sometimes slightly joined at the base, inner surface glabrous, outer glabrous or with extremely short hairs, margins red or white and finely ciliate, watery mucilage present during flowering. Inner cyme branch up to 2 cms. long, usually 1-sometimes 2-flowered, outer cyme branch up to 1 cm. long, 5- or 6-flowered. Posterior sepal boat-shaped with one stronger and 2 weaker nerves; anterior sepals large, broadly ovate, concave, fused together for 1/3 to 2/3 of their length, whitish with 3 pale green nerves. Posterior petals orbicular-reniform, unequal-sided at base, margin often irregular, about 1 cm. dia., claws rather broad, bright blue; anterior petal reniform or deltoid, about .6 cm. dia., margin irregularly toothed, tip bluntly triangular, claw short, pale blue, contained by the anterior sepals. Lateral stamens with long curved white or mauve filaments and small brownish anthers; median stamen with a straight filament about half as long as those of the lateral stamens, anther large and broad, yellow, brownish on the back, the cells curved. Staminodes 3, filaments about as long as the median stamen, heads large, sulphur-yellow, with 4 pouch-like lobes arranged in pairs and usually with a smaller lobe between the pairs. Ovary green, papillose; style straight below but standing at an angle so that the curved upper end and the stigma are in front of the stamens. Capsule ovoid-oblong, somewhat compressed, apex rounded or slightly retuse, about 1 cm. long, glabrous, 2-celled, 2-valves, 4-seeded, both valves remaining attached to the peduncle on dehiscence. Seeds ovoid-oblong, slightly compressed, truncate at one end,

3.5 x 2.2 mm., surface smooth, pale brown, often with a white deposit, a longitudinal brown scar on one face (hilum), and a round pit with a central point on one edge (micropyle).

On Karadimalai and a neighbouring spur, Gudalur Ghat, Nilgiris 4,500-4,700 ft. between rocks and amongst coarse grass. Flowers in July and August and probably during the rest of year as this area receives both the S.W. and the N.E. monsoon rains. Sheets Nos. 2265, 2310, 2311 in the writer's herbarium.

#### *Sequence of Flowering.*

Several plants were grown under observation at about 6,500 ft. on the Nilgiris. The flowers on the inner cyme branch are almost always male, having only a vestigial ovary with no style. A flower on the inner branch is usually the first to open and this is followed by a perfect flower on the outer branch. With 9 spathes, the perfect flower opened on the same day as the male on the inner branch in 2 cases, on the next day in 2 cases, after an interval of one day in 4 cases, and after 2 days' interval in 1 case. Subsequent flowers on the outer branch had variously reduced pistils or were perfect, depending on whether a capsule or capsules had been set or not. The intervals between consecutive flowers on the outer cyme branch were:— in 1 case 2 days, in 4 cases 3 days, in 8 cases 4 days, in 3 cases 5 days and in 2 cases 6 days. Sometimes two capsules are formed in a spathe, but usually there is only one and often none.

Spathes are usually at the end nodes of branches but other spathes may form later at the next lower nodes. A few specimens are found which have stiff white hairs on the outer surface of the spathe, on the upper side of the leaf and on the sheath and peduncle.

The rather large whitish anterior sepals and the large bright yellow staminode heads are characteristic. These with the bright blue petals and the red stems make this a striking plant.

#### *Commelina attenuata* Koen.

##### *Spathe and Flower.*

Spathes ovate-lanceolate 2.5 cms. long, the two halves folded together, base produced into two rounded auricles, tip bluntly acuminate, outer surface and margin glabrous, inner surface with small stiff white hairs except near the centre, central area pale and translucent, mucilage absent. Peduncle slender, about 2 cms. long, bent at the upper end, with fine white hairs along the inner side.

Posterior sepal broadly boat-shaped, base truncate; anterior sepals ovate, concave, joined for about 2/3 of their length, white, translucent with obscure green veins. Posterior petals orbicular-reniform, 6-7 mm. across, base shallowly cordate, claws straight, rather narrow, about 1/3 the length of the lobe, at about right angles to one another; anterior petal standing within the concave anterior sepals, broadly ovate, margin irregular, tip bluntly triangular, base cordate or slightly auricled, claw short and broad; all pale to deep blue. Lateral stamens with mauve filaments curved at the upper end, anthers yellow, broad, cells separated at base for about 1/3 of their length; median stamen with a slightly shortened filament, anther about twice as large as in lateral stamens, cells slightly curved and diverging at base. Pollen grains ovoid, slightly flattened on one side, .05 x .08 mm., surface spinulose. Three staminodes with filaments slender, straight, blue, a little more than half as long as the lateral stamens; heads with 2 larger, 2 smaller and usually 2 obscure round yellow lobes. Ovary green, papillose; style straight, inclined forwards.

#### *Sequence of Flowering.*

There are two cyme branches in the spathe. The inner is usually 1-flowered, sometimes 2-flowered; the outer may have 4 flowers. The inner cyme branch and the pedicels it bears are long so that the flowers stand far out of the spathe. On the first day of flowering there is usually a male flower on the inner cyme and a perfect flower on the outer cyme, or there may be a male flower on the inner cyme followed by a perfect flower

on the outer cyme the next day. After an interval of 2, 3 or less frequently 4 days, another flower opens; this is usually a second perfect flower on the outer cyme, but it may be a flower with a short style; in a few cases it is a second male on the inner cyme. After a second interval of 2 or 3 days there may be a third flower on the outer cyme which is sometimes perfect but more often has an aborted pistil.

As the removal of the earlier flowers from the outer cyme is found to cause the later flowers on that cyme to become perfect, it was thought that possibly the complete removal of the outer cyme might cause the flowers of the inner cyme to become perfect. In eight developing spathes the outer cyme branch was carefully cut out while it was in small bud (3-5 days before the first flower was due to open). In each case when the flower of the inner cyme branch opened it was found to be male, the vestigial ovary showing no sign of development.

#### *Self-fertilisation.*

The filaments of the lateral stamens and the style coil together. The filament of the median stamen arches at the upper end. The staminodes do not coil. The lateral stamens of the male flowers coil. Self-fertilisation is usually successful.

#### *Capsule and Seed.*

Capsule ovoid-oblong, apex truncate, surface smooth, 2-celled, 2-valved, 4-seeded. Both valves remain attached to the pedicel after dehiscence, and the dry spathe remains attached to the plant. There is usually one capsule each spathe, sometimes two.

Seed barrel-shaped, 4 m.m. long. ashy or pale brown speckled with black, a roundish cap at each end which is more or less gelatinous when the seed is first shed but on drying becomes white and honey-combed with round holes. Hilum a longitudinal brown line; micropyle a pale oval patch.

#### *Occurrence.*

This plant is common in grassy places on the plains of the East Coast districts and up to about 4,000 ft. on the drier slopes of the hills (Billigirirangans) and in S. Travancore (Udayagiri). It appears to be able to tolerate saline conditions as it is found on the seashore sands and round the salt pans at Covelong. The stems are prostrate and rooting occurs at each node if conditions are favourable. The roots are long and fibrous, and the plant appears to be an annual. It flowers during the moister months and dries off about March.

#### *Commelina benghalensis* Linn.

##### *Spathe and Flower.*

Spathe rather narrowly funnel-shaped, compressed, inner angle obtuse, outer acute, very shortly peduncled, outer surface with long jointed tapering hairs and numerous shorter jointed hairs with hooked tips, inner surface glabrous, mucilage present, solitary, usually leaf-opposed at the end node of a stem or branchlet. There are often a number of slender branchlets bearing several spathes one at each node opposite a small leaf.

Posterior sepal broadly boat-shaped, concave, tip green, inturned; anterior sepals obovate-orbicular, concave, joined for a short distance above the base, whitish with a median green vein. Posterior petals reniform-deltoid, unequal sided at base, 6.5 mm. across, claw rather broad about as long as the lobe; anterior petal ovate, tip triangular, turned in, claw short and broad; all dark blue. Lateral stamens 2; filaments blue, slightly curved at upper end; anthers small, dark blue, attached near the base; median stamen with slightly shorter filament; anther larger, yellow, cells curved and diverging. Pollen of the lateral stamens white, of the median stamen yellow, grains ovoid, ends bluntly pointed, .035-.04 x .015 mm., with a longitudinal groove, surface glossy, apparently with minute pits. Staminodes 3; filaments very slender, colourless,  $\frac{1}{2}$ - $\frac{3}{4}$  as long as the stamens; heads pale yellow with 4 larger and 2 smaller lobes. Ovary 3-lobed, pale green, style a little longer than the lateral stamens, upper end purple.

*Sequence of Flowering.*

There may be two cyme branches in the spathe but the inner is sometimes suppressed. In most cases there is a male flower on the inner branch and a perfect flower on the outer branch on the first day of flowering. Then on the next day or the day after there is a second perfect flower on the outer cyme, and there may be a third on the following day. Of 33 spathes that first opened a male flower on the inner and a perfect flower on the outer branch, 20 opened a second perfect flower on the outer branch next day, and 11 on the day after.

*Self-fertilisation.*

The filaments of the style and lateral and median stamens coil strongly at their upper ends. The style stands between the stamens, and the stigma is often in contact with the anthers of the lateral stamens before coiling has set in. The filaments of the staminodes do not coil. Self-fertilisation appears to take place very frequently, and to be successful. Of 18 spathes examined, 10 had 3 capsules, 5 had 2 and 3 had 1. In 24 capsules examined 22 had 5 seeds and 2 had 4 seeds.

*Capsule and Seeds.*

Capsules broadly ovoid-oblong, gibbous on the back and obscurely keeled, surface sub-glossy, very finely longitudinally furrowed, tip truncate, 2-valved, 3-celled, 2 cells 2-seeded, posticous cell indehiscent and 1-seeded. From flowering till the dehiscence of the capsule varied from 15 to 18 days (January and February), average about 17 days. When the capsule is about to dehisce the spathe turns yellowish and becomes detached from the plant. By means of the small hooked hairs on its outer surface the spathe will cling to a hairy surface and is no doubt often carried about by animals on their fur. The mouth of the spathe remains closed at first and the smaller seeds of the anticus cells are retained for some time owing to their rough surface. The posticous valve containing the indehiscent 1-seeded cell easily becomes detached from its pedicel, but owing to the wing-like portions of the anticus cells attached to it on each side, it is usually held in the spathe. The anticus valve remains attached to the pedicel.

Seeds of the anticus cells ovoid, one end truncate, the other rounded, 2 mm. long, flattened on one side, dull grey, minutely speckled with white, with irregular transverse ridges, a round depression with a central point on one edge (micropyle), an obscure longitudinal line on the flattened face (hilum). The minute white speckles are seen under the microscope to be more or less spherical excrescences.

Seed of the posticous cell ovoid, 3-3.5 mm. long, one side flattened, both ends rounded, a brown ridge on the flattened side (hilum), a roundish pit on one edge with a central point (micropyle), convex side about 7 ridges radiating from the micropyle.

The smaller seeds of the anticus cells germinate much more slowly than the larger ones of the posticous cell. Twelve seeds of each kind from the same capsules were placed on wet sand (February—early March); the larger seeds took 18, 19 and 21 days to germinate, and after 21 days no more seeds germinated; the smaller seeds germinated after 27, 32, 44, 49, 51, 64 days.

*Cleistogamous Flowers.*

This species produces cleistogamous flowers. In these the spathe is pear-shaped, one edge of the margin being folded over the other (right over left or left over right on the same plant). The outer angle is thus made into a point which may be useful in penetrating the soil. It is cream-coloured and covered with small hooked hairs on the outside; no mucilage is present. There is a single flower on a short jointed stalk. The petals are small and blue and do not expand, but remain enclosed by the sepals. There are three staminodes whose filaments are not coiled. The 2 lateral and the median stamen have their filaments coiled at the upper end and all yield pollen. The style is also coiled, and purple. The white underground runners bearing the cleistogamous spathes may be up to 20 cms. long, may have



6 nodes and may bear 3 or 4 spathes (one at a node). Three underground runners, a branch and 2 roots may originate at the same node of the stem.

There is every stage between normal spathes and cleistogamous ones—spathe green, 1-5 cms. long, opposite a large leaf, second spathe, above this, on a short shoot with a small green sheath opposite to a smaller spathe—shorter green slender branches bearing 2 or 3 smaller and narrower spathes each at a node and with a green-veined prophyllum opposite the spathe and a scarious prophyllum between the spathe and the axis. The prophyllums are like sheaths without the green blade but with a rounded end with a blunt apiculus, striated green with whitish transparent spaces between—slender downward pointing green branches with still smaller spathes and tips of petals separate—runners partly under the soil, the upper part only green.

#### *Distribution and Habit.*

This species is said to occur in all districts except the wettest (F.M.P.), but it has been collected by the writer on the Nilambur Ghat, which has a very heavy rainfall (about 150 inches). It occurs also on the Billigirirangan Hills at 4,000 ft., on the Elagiri Hills and in the Oucherlony Valley (Nilgiris) about 4,500 ft.)

The leaves vary to some extent in different localities; normal leaves, especially on their under-surface, have curved and some hooked hairs, and will cling to a woolly surface. The stems also have fine hooked hairs.

#### ***Commelina jacobii* C. E. C. Fischer.**

##### *Spathe and Flower.*

Spathes broadly ovate to almost orbicular (opened out), up to 2 cms. long and broad, base shallowly cordate, apex blunt or sub-acute, two halves folded together, each half strongly convex, margins closely approximated and fused together for a short distance above the base, four pairs of prominent nerves arching from base to apex, inner surface glabrous, outer covered with short hooked hairs; mucilage present during flowering; peduncle up to 1.5 cms. long solitary, leaf-opposed. When the spathe is at the end of a branch it is usually opposite to a small orbicular leaf about 1 cm. long.

Posterior sepal broadly boat-shaped, apex incurved; two anterior sepals broadly ovate, concave, not joined together, transparent. Two posterior petals with semi-circular lobes 7-8 mm. dia., outer sides cordate at base, inner truncate, claws long and narrow; anterior petal broadly ovate, tip bluntly triangular, margin with 2 blunt teeth on each side, bright blue. Two lateral stamens with long slender filaments and small yellow anthers, notched at base; median stamen with shorter straight filament and larger yellow anther with curved cells; pollen yellow, grains ovoid, slightly curved, one side flattened, .08 x .04 mm., surface finely and densely spinulose. Staminodes 3, sometimes only 2, filaments  $\frac{1}{2}$  to  $\frac{2}{3}$  as long as the longer stamens; heads bright yellow with 2 larger broad and 2 smaller narrow lobes arranged like the wings of a butterfly, 2 very small lobes often present between them. Ovary green, immersed in mucilage; style purple, as long as the longer stamens, curved so that the stigma stands in front of the stamens.

##### *Sequence of Flowering.*

In this species only the outer branch of the cyme is fertile; the inner branch is slender, only a few mm. long and with a gelatinous tip. Twenty-nine spathes of plants from the Gingee Hills grown at Tambaram were marked (August). Each first produced a perfect flower. Eleven spathes had no second flower. Ten had a second perfect flower on the following day, and 4 after an interval of 1 day. The second flower in four spathes had an imperfect pistil (style short and coiled), two on the next day and two after an interval of one day. One spathe had three complete flowers on successive days. It was noticed that as a plant grew older its spathes more frequently had only one flower.

A plant of this species found on the Elagiri Hills at about 2,000 ft. was grown at Tambaram and flowered in March. Of twelve marked spathes, ten first produced a perfect flower, and two had perfect flowers on the outer cyme branch open together. This is very rarely observed. Of these twelve spathes



8 had no subsequent flower; 3 had a second complete flower on the next day, and one had an imperfect flower after an interval of a day.

From the opening of the flower to the dehiscence of the capsule is about three weeks.

#### *Self-fertilisation.*

The filaments of the two lateral stamens and the style coil together. The median stamen and the staminodes do not coil, but they may become involved in the coiling of the style and lateral stamens. Self-fertilisation appears to be effective.

#### *Capsule and Seed.*

In the small form from the Elagiris grown under observation at Tambaram, only one capsule was formed in a spathe. Spathes of the large form found at Kallar (Nilgiris) had up to three capsules .85 cm. long. Capsule oblong, 3-celled, 2-valved, 5-seeded when fully developed. The posticous valve deciduous, containing the 1-seeded indehiscent cell; the other two cells each containing two seeds which fall out when dehiscence occurs. After dehiscence the sutures of the valves are seen to be strongly wavy. The outer surface of the deciduous valve is yellowish-brown and completely covered with fine longitudinal wavy ridges; it has also an obscure longitudinal keel. Seed of dehiscent cells ovoid oblong, slightly flattened and curved, 4-4.5 mm. long, 2.5 mm. broad, pale pinkish-brown with black markings, one face with a curved black slit (hilum), the other with a pit containing a small conical projection (micropyle), the convex edge with 3 transverse tubercled ridges; seed of the indehiscent cell with about 5 radiating ridges which can be seen as undulations on the surface of the cell. The spathe becomes detached soon after the capsule opens, but its margins remain pressed together. It clings to hairy surfaces by the hooked hairs with which it is covered and is probably carried about by animals. The seeds because of their tubercled ridges, and the one-seeded valve because of its wings and rough outer surface are held in the spathe and are thus dispersed.

#### *Occurrence.*

This plant was found at Coimbatore and in the Salem District by Mr K. C. Jacob. It has been found by the writer along a stream on the slopes of the Elagiri Hills, North Arcot District, at about 2,000 ft. flowering in December, on the Gingee Hills, South Arcot District, and at Kallar, Nilgiri District, at 1,700 ft. (mature capsules July). The Kallar plant was a large form with stout stems and leaves up to 10 cms. long and 4 cms. broad, the apex acuminate. The spathe with its two convex halves having their margins pressed together, and the very characteristic capsule and seed enable this species to be identified with ease. The roots are slender and yellowish. Rooting occurs at the lower nodes. The plant is able to carry on from year to year if conditions are favourable.

#### *Commelina forskalaei* Vahl.

##### *Spathe and Flower.*

Spathe irregularly funnel-shaped, compressed, outer angle acute, inner rounded, up to about 1.4 cms. long, with 3 prominent pairs of nerves, inner surface glossy, outer covered with very short hairs and the basal half with numerous long stiff tapering colourless hairs, margin often red; peduncle shorter than the spathe. Mucilage is present during flowering. Cyme branches pubescent.

Posterior sepal broadly boat-shaped, 2 anterior sepals ovate, concave, tinged blue. Posterior petal orbicular-cordate, unequal-sided, 8 mm. dia., claws narrow and at about right angles; anterior petal lanceolate, concave, shorter than the sepals between which it stands; all petals deep blue, veins darker. Stamens about  $\frac{1}{4}$  the length of the lateral stamens, filaments slender, heads usually with four narrow yellow lobes arranged like a cross but one or more lobes often lacking. Lateral stamens with long thick deep blue curved filaments, the upper halves of which are flattened and broadened; anthers narrow, greenish-blue. Median stamen with a shorter filament not dilated

above; anther large, greenish-blue, the cells curled above, diverging below and with yellow auricles at the lower ends. Ovary glabrous, style blue, curved forward. Vestigial ovary present in male flowers. The broad flattened upper parts of the anthers of the lateral stamens are distinctive.

#### *Sequence of Flowering.*

In this species the inner cyme branch is usually one-flowered, occasionally barren; the outer branch has 3 to 5 flower buds. On the first day of flowering there is usually a perfect flower on the outer branch and a male flower on the inner. Much less frequently there is a complete flower on the outer branch followed next day by a male on the inner. In spathes that first opened two flowers simultaneously there was in 7 out of 10 cases an interval of two days before another flower opened, and in 3 an interval of one day. If the first complete flower on the outer branch has set a capsule, the second flower has a small ovary with a short coiled style; if a capsule has not been set the second flower is perfect. Usually only one capsule is formed in each spathe. The single male flower on the inner cyme branch drops after flowering.

#### *Self-fertilisation.*

The two lateral stamens coil outwards. The median stamen bends but does not coil. The style coils and the stigma is generally brought into contact with the anther of the median stamen. The staminodes do not coil. The lateral stamens coil in male flowers. Self-fertilisation appears to be successful.

#### *Capsule and Seed.*

Capsule sub-cubic, buff-coloured, 3-celled, 2-valved. The posticous valve is deciduous and contains the one-seeded indehiscent cell. The other two cells are 2-seeded. The outer surface of the indehiscent cell is finely longitudinally furrowed and has a number of narrow wings at the sides. Seeds spherical, compressed, about 3 mm. dia., yellowish-brown mottled lighter, surface smooth, with a blackish groove on one face (hilum).

This plant is very common in grassy places near Coimbatore. It either runs along the ground rooting at the nodes, or it becomes erect and 20-25 cms. high. It produces underground cleistogamous flowers freely.

#### *Commelina undulata* R.-Br.

##### *Spathe and Flower.*

Spathes irregularly funnel-shaped, compressed, outer angle acute inner rounded, up to 2 cms. long, outer surface covered with short hairs hooked at the tip, and with some long bulbous-based jointed white hairs, inner surface glabrous, musilage present; peduncle up to .5 cm. long, colitary, leaf-opposed, near the ends of branches.

Two anterior sepals broadly ovate, concave, fused together for half their length or less, white with transparent margins; posterior sepal broadly boat-shaped, smaller. Two petals with semi-circular lobes, about 1-1.2 cm. across unequal-sided, standing opposite one another so that the straight sides are parallel, claws rather broad, about  $\frac{1}{3}$  the length of the lobe; third petal small, narrowly ovate or lanceolate, shorter than the two larger sepals between which it stands; all bright blue. Staminodes three, similar, with slender filaments about half as long as that of the median stamen and with yellow six-lobed heads, 2 lobes roundish, 2 elongated and diverging and 2 very small. Two lateral stamens with long blue flattened filaments bent like calipers, anthers small, dark blue, the cells separated below the attachment; median stamen with a shorter tapering anther much larger, yellow margined bluish-green, the two cells much curved above and strongly diverging below, each with a yellow upturned auricle at the base. Pollen almost white; grains ovoid-oblong, .07 x .045-.05 mm., the surface densely and finely spinulose. Ovary green, style blue, sigmoidly curved so that the stigma stands in front of the anthers.

The two semi-circular blue lobes of the posterior petals standing with their straight sides parallel, and the yellow auricles at the bases of the

cells of the anther of the median stamen are characteristic features of the flower.

#### *Sequence of Flowering.*

In this species only the outer branch of the cyme is developed, the inner being aborted to a flowerless axis about 1 mm. long. The outer cyme branch rarely bears more than four flowers. Thirty-five spathes of plants growing at Tambaram were marked (Dec.-April). In each case the first flower to open was perfect. In 25 cases the second flower was also perfect and in ten the pistil was incompletely developed. Twenty of these second flowers opened after an interval of 1 day, 12 after 2 days, and 3 after 3 days. A third flower opened in 23 spathes, and of these only 3 were perfect, the rest having infertile pistils. One of these opened on the next day to the second flower, 15 after an interval of 1 day, 6 after 2 days and 1 after 3 days. Only 9 spathes produced a fourth flower, and all of these were male; 6 after an interval of 1 day, 3 after 2 days and 1 after 3 days. It was found that almost invariably an imperfect flower indicated the presence of a capsule in the spathe from a previous flower. Imperfect flowers have longer pedicels and so stand further out of the spathe than perfect ones. Male or imperfect flowers have all three stamens fertile but the pistil reduced to a small ovary with a short usually coiled style, or the ovary may be almost completely absent.

#### *Self-fertilisation.*

In perfect flowers the filaments of the lateral stamens coil and the style coils; the filament of the median stamen arches at its upper end so that its anther is bent down and may become involved in the coiling of the style; the filaments of the staminodes do not coil. The lateral stamens coil in male flowers. Self-fertilisation is successful.

#### *Capsule and Seed.*

Usually one capsule matures in each spathe but sometimes there are two. Capsule broader than long, 3-lobed, apex truncate, surface smooth, buff, 3-celled and 3-valved, there being one seed in each cell when fully developed, the 3 valves remaining attached to the pedicel. Seeds almost spherical, dark grey or black with lighter mottling, surface slightly roughened, a narrow brown groove (hilum) on a slightly flattened face and a raised blistery band almost encircling the seed; a pit with a point between the ends of the band (micropyle). From opening of flower to dehiscence of capsule varies from 17 to 24 days. The spathe becomes detached from the plant when the capsule dehisces. The small hairs on the outer surface of the spathe enable it to cling to, hairy or woolly surfaces and it is probable that animals thus help to distribute the seeds.

#### *Occurrence and Habit.*

There are at least two forms of this species. The commonest is prostrate and occurs in open grassy places on the plains in the eastern districts (Chingleput, Nellore) and in cracks in rocks on dry hillsides up to 4,000 ft. (Billigirangan Hills).

This form is tufted and the stems are usually short and rest on the ground. The bases of the stems are swollen and united into a clump. At first the condensed lowest internode of each stem is top-shaped, but later the second internode also thickens and an oblong corm-like body about 1.3 cms. long and up to 1 cm. across is formed. These bodies persist after the upper parts of the stems have dried off. Fresh stems originate from buds at the bases of these bodies, and eventually a large clump is formed. The material of these stem bases is firm and white and consists largely of starch. These bodies no doubt function as corms and enable the plant to survive through the dry season. From the under side of these corm-like bodies there are long slender tuberous roots. These roots are cylindrical, about .35 cm. across near the top, and taper gradually downwards. The flesh is succulent and in the older roots the core contains starch. The surface of these roots is covered with a dark brown felty covering. At first it was thought that this felty

layer might indicate the formation of a mycorrhiza but microscopic examination shows it to consist of numerous dried root-hairs.

Rooting does not occur at most nodes but in favourable conditions some of the nodes near the ends of the stems may root, especially if there are side branches from these nodes. After rooting the bases of the side branches thicken and a tuft is formed, which may then develop into an independent plant.

This plant is perennial and will stand hot dry conditions better than any other South Indian commelina. It may be found flowering freely in exposed places till late in April, some weeks after the grasses and other herbaceous plants have dried off. The flowers open at sunrise, earlier than other species. It has rather thick narrow leaves, the two halves partly folded together.

A second form occurs in the same districts but is found in the shade of thickets. It is first erect and when the stems get long they straggle over shrubs and may become 6 ft. in length. It has thinner, rather broader and flatter leaves. It does not flower freely. A similar plant was found at about 3,000 ft. at the foot of the Sigur Ghat, Nilgiris. The tall form also has enlarged stem bases.

### *Commelina kurzii* Clarke.

#### *Spathes and Flower.*

Spathes clustered at the ends of the branches where there may appear to be up to about seven spathes at a node. Examination shows that there are two or more nodes very close together, each with one spathe opposite a leaf, and often the end of the branch is shortly bifurcated, each part having several condensed nodes. There are also short scarious triangular cataphylls at these nodes. Spathe irregularly funnel-shaped, the two sides folded together, outer angle acute and acuminate, inner rounded, 2.2-5 cms. long, outer surface with long scattered hairs and many short hairs hooked at their tips; peduncle up to about .5 cm. long.

Posterior sepal small, broadly boat-shaped; two anterior sepals broadly ovate, concave, fused together for  $\frac{1}{3}$  to  $\frac{2}{3}$  of their length; all colourless. Two posterior petals with approximately circular lobes unequal-sided at the base, up to 1 cm. in dia., claws narrow, straight, standing at a little less than right angles to one another, mauve; anterior petal lanceolate, only about as long as the claws of the others; tip acuminate and curled in, colorless. Two lateral stamens with long arching filaments and small anthers; median stamen with shorter and stouter filament, anther large, yellow, with curved cells diverging below, each cell having a flat yellow auricle above its base. Pollen cream-coloured, grains ovoid-oblong, .08-.09 x .04 mm., surface finely spinulose. Staminodes 3, filaments slender about  $\frac{1}{3}$  as long as lateral stamens, heads yellow with four larger pouch-shaped lobes and two smaller ones. Style about as long as the lateral stamens, curved forward so that the stigma stands in front of the samens; ovary green, smooth, immersed in mucilage.

#### *Sequence of Flowering.*

The spathes on the same branch form successively. Normally only the outer branch of the cyme develops, or inner being represented by a bud at the base of the spathe; very rarely the bud develops to a long pedicelled male flower which opens with the first flower of the outer cyme. The spathe of the Vandalur form contains mucilage during the flowerng period, but this is not so with the Sigur Ghat form. During December and January, 21 spathes of the Vandalur form of this species were marked. The first flower produced by each spathe was perfect. In two spathes the second flower opened after an interval of 1 day, in 2 after 2 days, in 13 after 3 days, in 3 after 4 days and in 1 after 5 days. Three of the second flowers were perfect, and 18 had the pistil incompletely developed but the stamens normal. Only 3 spathes produced a third flower, and all of these had imperfect pistils. These flowers opened after intervals of 3, 4 and 5 days. It was thought that the incomplete development of the pistil in the second or third flower of a cyme might be conditioned by the presence of a developing capsule from an earlier flower. Experiment showed this to be the case. Eleven spathes, each with a perfect flower, the first on its cyme, were marked, and each of these open flowers was cut off

without damaging the rest of the cyme. In each case the second flower was perfect. The interval between flowering was reduced by the removal of the open flower. One of these spathes opened its second flower the next day, 7 after an interval of one day, 1 after 2 days, 1 after 3 days and 1 after 4 days. Four of these spathes subsequently produced a third flower, each of which was imperfect. It was also found that if the first and second flowers were cut off when they opened, the third flower became perfect. Further, four spathes in which the first flower had formed a capsule and the second flower was imperfect, had the capsule and imperfect flower cut off. After an interval of two days three of these spathes produced a perfect flower, and the fourth did so on the following day. Imperfect flowers have longer pedicels than perfect ones and stand further out of the spathe.

The flowering of narrow-leaved form of *C. kurzii* brought from the Billigirirangan Hills and grown at Tambaram was a little different from that of the Vandalur form. In October it began to flower and 16 spathes were marked. Each first produced a perfect flower. Five produced a second flower after an interval of 1 day, 9 after 2 days, and 2 after 3 days. Seven second flowers were perfect, and 9 had the pistil undeveloped to various degrees. Thirteen spathes had a third flower, 2 of which were perfect, and 4 had fourth flowers, all of which were incomplete.

The form of this species with larger leaves and thicker stems occurring on the Gingee Hills flowered in August. Three first flowers were perfect; two second had undeveloped pistils and opened after an interval of one day, and one second had undeveloped pistils and opened after an interval of one day, and one second was perfect and opened the next day and was followed by an incomplete flower.

The Sigur Ghat form was grown at Kalhatti (about 1,500 ft. above its habitat). First, second and third flowers were all perfect. The intervals between successive flowers varied from 2 to 5 days, averaging about 3 days.

#### *Self-fertilisation.*

In this species the filaments of the two lateral stamens and the style coil before the flowering is over. The filament of the median stamen bends at its upper end but does not coil. First the filaments of the lateral stamens arch inwards so that the pollen-bearing surfaces of the anthers face inwards and approach the large anther of the median stamen. The style then curves and the stigma is usually brought into contact either with the anther of the median stamen or with one of the lateral ones. Often the style subsequently coils round the large anther of the median stamen, whose shape appears to be specially adapted to receive the coiling style. Subsequent coiling of the lateral stamens may again bring their anthers in contact with the stigma. The time of coiling is of course affected by temperature, exposure and other external factors. At Tambaram in April, it was found that by 10 a.m. the style had made one complete coil and had often encircled the large anther. The filaments of the lateral stamens had at this time become strongly arched. By 11 a.m. the lateral stamens had completed one coil, and by noon they had completed two or three coils, and the style, if not obstructed, had formed three coils. Eventually the style and the lateral stamens are usually coiled together round the anther of the median stamen. The filaments of the lateral stamens coil even in flowers with undeveloped pistils, and the coiling occurs rather earlier. When the filaments of perfect flowers had made one coil, those of imperfect flowers were found to have made two. The filaments of the staminodes do not coil. In the Sigur Ghat form grown at Kalhatti (6,600 ft.) the coiling did not begin till after midday, and was not complete till after 3 p.m. The mechanism for self-fertilisation is very effective.

#### *Capsule and Seed.*

The capsule is 3-seeded and 3-celled and 2-valved. When it opens the posticous valve falls off. This valve contains the indehiscent cell which contains one of the seeds. The convex outer side of this valve is roughened by longitudinal ridges. The other valve remains attached to its pedicel in the spathe but the two seeds fall out. The spathe becomes detached and gapes when the capsule becomes mature. The two free seeds usually fall out of the spathe, but the third, owing to the wings and the rough surface of the valve that contains it, is often held in the spathe. The hooked hairs on the outer surface of the

spathe make it liable to be carried by animals and thus the contained seed is dispersed. Usually only one capsule matures in each spathe. Of 28 fruiting spathes 23 contained only one capsule, and of the other five that contained two capsules, only two had both capsules with all three seeds.

The interval between the opening of the flower and the dehiscence of the capsule appears to depend on temperature; in November and December it varied between 29 and 34 days, and in March it was from 22 to 25 days.

The seeds are broadly ovoid with 2 somewhat flattened adjacent sides, surface dull dark grey covered with minute white grains. There is a brownish scar along the edge between the flattened sides (hilum). A brownish or grey blistery ring almost encircles the seed, and between the two ends of this ring there is a small crater-like depression with a central point (micropyle).

#### *Forms and Occurrence.*

This plant grows between rocks from a little above sea-level to about 5,000 ft., under the shade of shrubs or trees in the hotter areas, in open places at higher elevations. There are a number of local forms differing chiefly in habit and leaf shape, but all have similar flowers, spathes and capsules. All forms seen by the writer have mauve petals and not blue as stated in Clarke's Monograph, F.B.I. and F.M.P.

The form found at Vandalur (Chingleput District, 100-200 ft.) has slender trailing stems and broad leaves (up to 10.5 x 2.8 cms. but usually smaller). The Gingee form is similar but more robust and has the outer surface of the deciduous valve of the capsule tubercled and the spathe almost glabrous. A similar plant but with hairy spathes occurs on the Sigur Ghat (Nilgiris) at 4,500 ft. One form found in the Billigirirangan Hills has long narrow leaves (11 x 1.6 cms.) and a trailing habit. A second is like the Gingee form but still more robust (leaves 15 x 4.3 cms. spathes 2.3 cms. across). A third form found on these hills is more or less erect and has broad but acuminate leaves and spathe with acuminate outer angle. A similar plant occurs on the Gudalur Ghat, Nilgiris, and at 5,000 ft. on the Shevaroys. The narrow-leaved form from the Billigirirangan Hills and the broad-leaved Vandalur form when grown under identical conditions at Tambaram for 2 years remained distinct, showing that the differences are not due simply to environment.

This plant roots readily at the nodes if they are in contact with moist earth. Root buds are present at other nodes but they do not develop. The lowest internodes of the stems thicken to small top-shaped bodies which together form a clump. These bodies contain much starch and function as corms enabling the plant to survive the dry season. From these stem-bases numerous slender fleshy roots emerge. They are about 3 mm. across and up to 5 cms. long and contain a good deal of starch in a layer round the centre. The outer surface is covered with a dark brown felt consisting of numerous dried root hairs.

## A BIRD PHOTOGRAPHER'S MUSINGS FROM KASHMIR.

BY

LT.-COL. B.T. PHILLIPS.

(With 8 plates)

Soon after gaining a little confidence in my newly invented gadgets for 'distant release' bird photography, and pleased at finding they were instrumental in producing unposed and natural results of bird life, I decided to go further afield and spend my two months' leave in Kashmir. I was lucky having June and July at my disposal, though an earlier date might have been more favourable for the purpose. Within a day or so of my arrival in Srinagar I was lucky to find a bird shikari who had been recommend-

ed to me as good; with all his shortcomings, a grand old red-beard, Habiba of Shalibug—an expert at birds in and around the lakes and marshes, and a willing henchman to boot.

In spite of the good recommendations received, the usual ceremony of at least pretending to wade through the wad of 'chits' (testimonials), handed you with pride in true 'die-hard' '*Dastur Hai*' (customary) fashion, had to be respected. Habiba was taken on for the period of my stay.

With a very hazy knowledge of the birds that might be met with, and with visions of fresh fields to conquer, it was pleasing to find at one's disposal a tested guide. The first outing was arranged—a run out to the River Sind at a point only 20 miles from Srinagar. The objective was a photograph of a Common Sandpiper which had a nest with a freshly completed clutch of eggs. A start by car was made early next morning. The drive for the first five miles along the Ganderbal Road, through the crowded city and a network of congested villages, is a corrective to ideas culled of novels, telling of the romance of the East. From this point onwards Nature asserts itself. The country opens out with a panorama showing to the west, Anchar Lake, a broad sheet of water alongside the road, overshadowed in the distance by the snowy Pir Panjal Range; to the east, a broad valley of arable and pasture land gradually rising to a lofty ridge of mountains.

Those ubiquitous townsfolk, the crows, the kites, mynas, and sparrows, though still to be seen, do not intrude with such unfailing familiarity now that the open country is reached, yet there is no diminution in bird life. The avian world appears to be just as busy and affords great variety both in species and vivid colourings. The beloved English Swallow is present and will be seen flying with speed and grace in these open spaces, twittering as it hawks insects over the paddy fields or rests on the telegraph wires by the road.

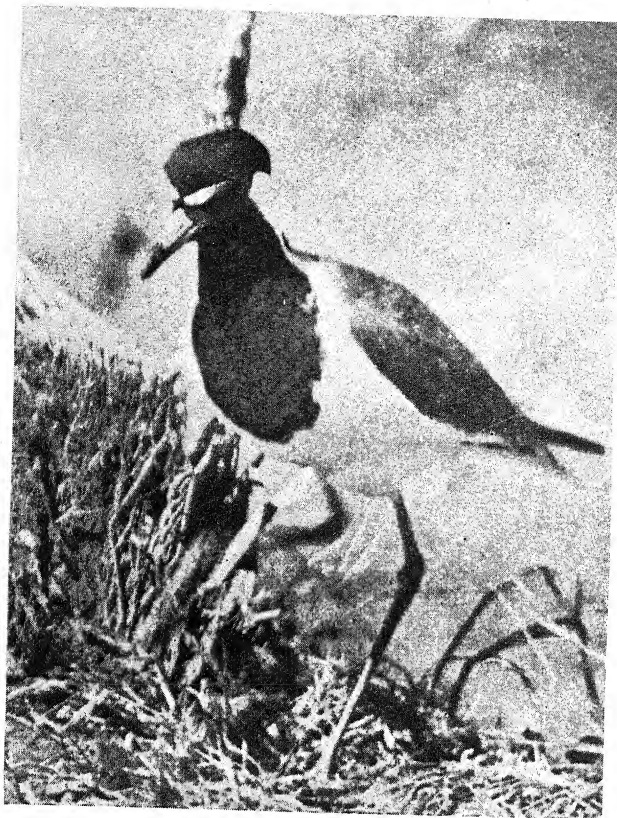
From a neighbouring post a vision in Oxford and Cambridge blue swoops down to the ground to pick up a cricket or grasshopper and return to its post, or flashing in the sun, it launches itself with harsh, grating screams in fantastic gyrations to display its beauty to the mate of his choice. This is the Kashmir Roller.

Many others will attract attention but as my main object was to try and get series of photographs of the Sandpiper, still some fifteen miles distant, I tried to keep to the task in hand, but failed. No sooner was the car in motion than I heard fantastic cries of a 'Did-he-do-it' uttered repeatedly, and looking across the fields in that direction saw a bird apparently fiercely attacking a ryot who was crossing some fallow land.

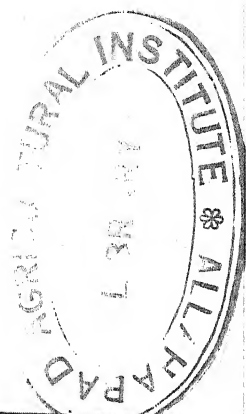
### **The Red-wattled Lapwing *Lobivanellus indicus*.**

This Lapwing, a bird common round Cantonment areas in the Plains, was known to me, and therefore this persistent behaviour aroused my suspicions. The car was once again brought to a standstill to enable me to watch more closely through binoculars. The birds in view alighted apart, making it difficult to watch both

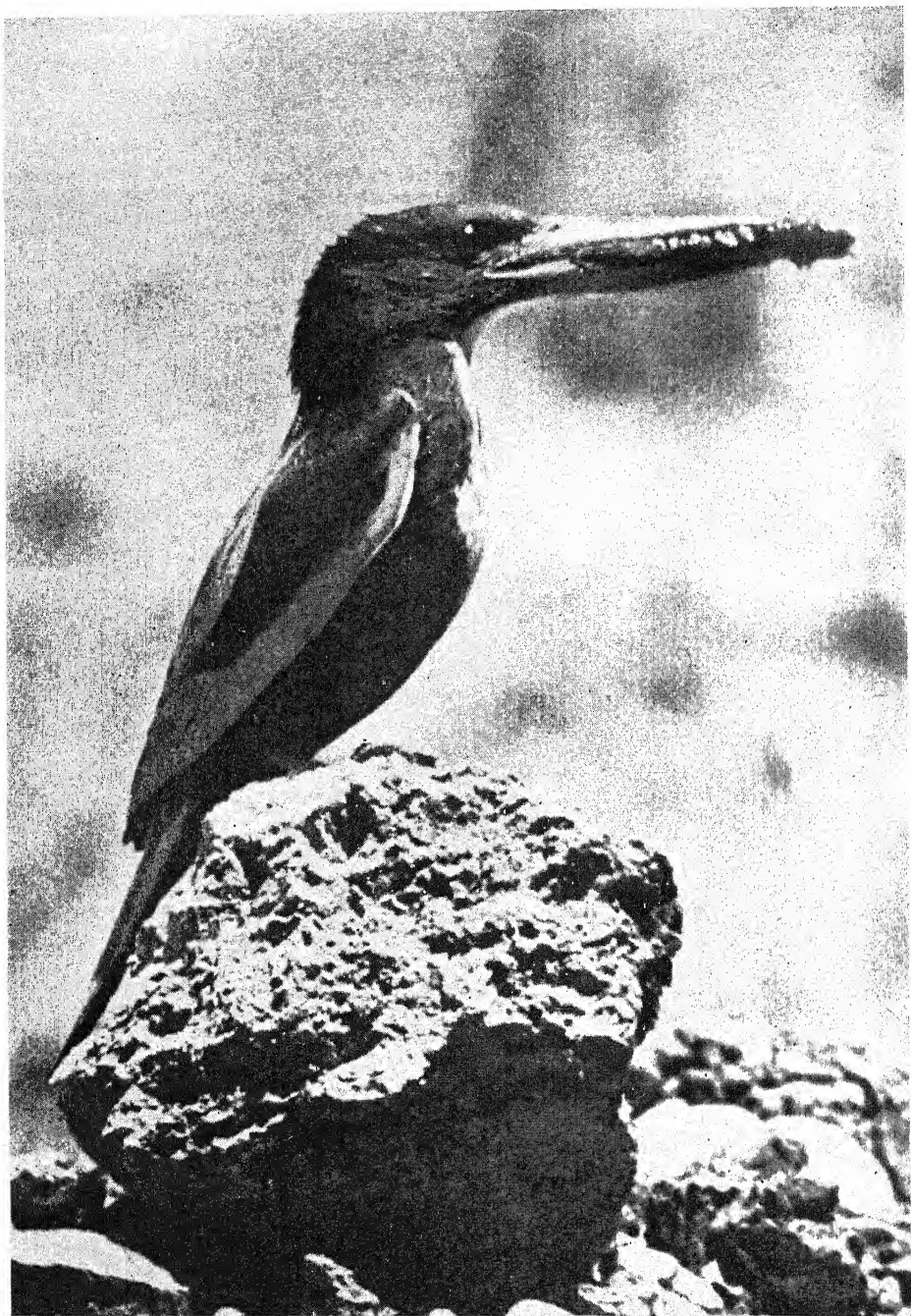




*The Red-wattled Lapwing.*







*The White-breasted Kingfisher.*

of them. Soon it became obvious that one was feeding owing to its bearing,—upright stance, and occasional, typical short spurts to capture stray insects.

My attention was quickly centred on the other bird. It was carefully moving across the field in a crouching attitude and with gliding gait; it must have covered twenty yards or so in this manner before settling down. Five minutes passed, the bird was still sitting. Had a nest been found? Do not let excitement at discovery set one into wild rush for the site. Much caution is necessary. The quarry is wide awake and though the size of a partridge and strikingly coloured, the pattern of the plumage harmonizes well with the surroundings. Slipping away from the nest, while one is still in the distance, it detracts attention from the all-important focal point—the nest, there is nothing to see but a jumble of ploughed land, or an equally confusing stretch of grass. The nest itself does not help one in the search, it is a mere scrape in the ground encircled with small stones or pellets of clay to suit the surroundings, and the eggs, blotched and streaked in black also closely match the site and nesting materials chosen. The ground colour of the eggs may vary with the colours of the soil; it is a stone colour in boulder-strewn areas, a creamy buff in clay and, I have read, even a reddish buff on red lime-stone.

The nest was found and it contained four pear-shaped eggs large for the size of the bird. This caused the first interruption. The camera and apparatus had to be set up.

The birds did not appear to mind the camouflaged 'set up', in fact, I was scarcely given time to reach the switch before the bird would settle down, in spite of the pandemonium created during their feigned attacks on me at each visit to the camera. An obstacle commonly met with in all cases where birds build on flat featureless ground is the difficulty of visualising the pre-focused area. Many good action pictures are thus ruined as the subject is found to be out of focus. Before leaving for home that evening it looked as though further interruptions in the original plan for the day's outing were in the offing. A Skylark, having completed its exuberant song in the heavens, dropped down into the pasture and not far from the sitting Lapwing, and a band of gaudy European Bee-eaters seemed to be attached to a certain reach of a fairly deep-sided nullah, also in view.

### **The Kashmir Skylark.** *Alauda gulgula guttata.*

An early arrival in the area next morning brought back pleasant memories of pastures green and the English South Downs. There were several skylarks hovering in the heavens giving vent to their spirited and joyful song. Now one, now another would drop like a stone with closed wings earthwards, falling lower and lower until it finally settled. Being a bird with inconspicuous striated plumage, no larger than a sparrow it is very difficult to see when on the ground owing to its crouching gait. After two or three attempts at flushing the female bird in the areas indicated by recently grounded males. I was about to resort to the school-boy trick of trailing over the surface of the field a cord, some



twenty yards in length, held at the extremities by my shikari and myself, when a lark sprang up from under my feet and fluttered away. A careful search revealed the nest; a little cup on the ground, lined with fine grass, well screened from view, under a low spreading creeper-like growth. It contained four eggs, their white ground almost entirely concealed by fine brown spots.

The camera was set up and, after much searching, a vantage point gained from which to view the approaches to the nest, but had it not been for a red poppy placed to mark the site, its exact position would have been hard to pick up. Quite a half hour passed without any sign of the bird in this matted area, so an attempt was made to improve the look of the camouflaged camera. To my surprise the sitting bird flew away from the nest! Similarly, on two separate occasions the bird was flushed off the nest without having given any indication of its approach. It would seem that its 'obliterative' plumage, its crouching walk, its squatting was too much for my watchfulness, and so, after a vain three hours of failure, I flattened down a 9-inch wide drive around the nesting site. This ruse succeeded. I was able to snap the bird often on its approaches to the nest, its markings standing out well against the sandy background.

In my ignorance I thought, I had pictures of the Crested Lark, as occasionally an untidy moppish crest became visible. The Crested Lark is easily distinguished by the erect tuft of pointed feathers on the crown. It does not breed in the Vale but takes up its summer quarters on the higher mountain ranges of Ladakh and Central Asia.

### **The European Bee-eater. *Merops apiaster*.**

The tell-tale burrows in the banks of the nearby sandy nullah gave sufficient grounds to place the photography of this bird next on the list.

May and June are two nice sunny months in the Vale and thus, day in and day out, no qualms as regards brilliant morning lighting need be anticipated, but a banking up of heavy thunder clouds may however mar an afternoon session. It was a delight next morning to see this most colourful and ornamental bird in brilliant sunshine at close quarters.

Being gregarious by nature and nesting in colonies, a flock was concentrated in this area. The birds showing preference for being more on the wing than perched, provided an excellent view of their graceful, easy and undulating flight—a few rapid wing beats alternating with a sail through the air; a pleasant whistling trill is uttered at intervals.

The bird is slenderly built and larger than a bulbul. Its brilliant yellow throat, graded blue-green under plumage, chestnut crown and mantle show off to advantage as it manoeuvres with elegant, wide wheeling sweeps. There are several nesting colonies dotted about the Vale in suitable localities, where the soil is firm but sandy. Some choose banks of nullahs, others colonise hillocks and yet others prefer to excavate their tunnels, even on level ground.

During two successive summers a pair chose a bunker on the

busy Srinagar Golf Course, and undeterred by the bellowing sounds of annoyance from golfers, successfully brought up their families. Apart from such disturbance it was thought advisable to divert caddy activity by having all caddies told to warn users of this well placed bunker that a big snake had been seen entering the hole.

The nesting tunnels, about three inches in diameter, are driven deep into the earth. For interest I had one dug out after the young had flown, and found a network of other tunnels, criss-crossing the line before the nesting chamber was reached.

The whole area appeared to form an underworld, judging by the miscellaneous collection of frogs, lizards, and beetles. I have seen the spherical white eggs and am told six from the usual full clutch in Kashmir.

My subjects for the day were building and so busy tunnelling that they afforded little chance of getting good pictures with the camera focused on the nesting hole. They scarcely paused at the entrance on arrival; though some would settle on a bare twig sticking out of a low bust on the bank before making for the tunnel. The camera site was chosen, but the setting up of the apparatus about 12 ft. away made the birds choose other convenient twigs further off. I found, times out of number, that patience and a little thought will overcome most bird problems. Allowing time enough for the birds to get used to the camera, a clod of earth was placed to block up each of four separate new burrows. The idea worked like magic. The birds presumably dismayed by this manoeuvre had their attention diverted from the camera. Seven of them sat together on my chosen twig. Had the electric release worked I might have got a picture of them all; however there were many snapshots taken of single birds, and on three occasions a pair on the same twig. Needless to say the clods were removed on the completion of the photography and the birds were busy at their work before I quitted the scene. It may be mentioned that a dapper little male Indian Bush Chat, in his neat black and white suiting, and a rich chestnut vest, also used this perch during the day and allowed himself to be successfully photographed on three occasions. A careful search revealed its nest, which contained four eggs, including a cuckoo egg, which was duly destroyed.

The tale from here onwards continues to produce many attractions, to upset my original plan, but as the Sandpiper's eggs were fresh, a few days' postponement appeared permissible. Though the small area just worked had been prolific in subjects for the camera, yet it proved to be only a taste of what was to come in this bird paradise. It was not a mile beyond this spot that the road passed over a narrow tortuous nullah, about 25 ft. wide at ground level but shelving steeply to a tiny stream, another 25 ft. lower down. The sharp twittering cries from a disturbed Pied Kingfisher, and the exit of a Kashmir Roller from the depths of the nullah, called for further investigation.

The precipitous side of the nullah was found to be honeycombed with Pied Kingfisher burrows, old and new. Those in use were zealously guarded by the seven pairs in residence to prevent

rude gate-crashings by pompous and pugnacious Mynas. Ubiquitous House Sparrows, always so ready to usurp anything if permitted to do so, and finally by timid Starlings.

Two pairs of Kashmir Rollers with burrows in the same banks, also swooped down from their vantage points on a tree or telegraph wire, to keep order in this circumscribed aviary. The few willow trees thriving in the cutting gave asylum for the nests of a pair of White-cheeked bulbul, and the Rufous-backed Shrikes.

There were even two pairs of the Central Asian Kingfishers that had driven their tunnels into the bank, not more than a foot or two above the stream. Finally from this very road bridge, a pair of Hoopoes could be seen busy feeding their young, sheltered under the roots of a lofty Chenar.

To give some idea of the congestion in this area, from the 'hide' I had set up half way down the bank, I was able to take close-up pictures of seven different species by simply having to swing round the camera on its stand. Three days sufficed to complete these series, the first being employed in accustoming the birds to get used to the 'hide'.

I now propose to describe the birds using the nullah, omitting descriptions of garden and house birds, as these will be described in a subsequent chapter.

### **The Pied Kingfisher.** *Ceryle rudis leucomelanura.*

This pied bird is a little larger than a myna with sexes alike in the main, the only striking difference to be noticed in the field shows when the birds are viewed frontally. The male has the two black gorgets across the breast, the broader one above; the female sports only one which is incomplete being interrupted by quite an inch of white breast feathering.

These birds are numerous and resident in the Vale, and I am of opinion that their numbers remain constant throughout the year. There are many nesting colonies in the vicinity of the Lakes each used by not more than about a dozen couples. Most of these localities appear to have been used by these birds over a period of years. The bank faces are riddled by their tunnellings, and it is evident that the burrows are used as shelters during the winter months, as, nearing sunset many birds congregate in the area and have been seen entering the holes. One unusual colony is situated at a distance of over two miles from the nearest water. The eggs, glossy white and spherical in shape, are said to number six to a full clutch.

They are noisy birds when courting, and being 'hale fellow well met', are delighted when a passing friend drops into the community. Pandemonium then reigns, while with short black crests raised, wings quivering, tails jerking up and down, everyone greets the newcomer with excited chirrupings.

When passing along one of the many waterways, the wayfarer's attention must be attracted either by their pleasant cries, or by their hoverings high over the surface, awaiting the propitious moment to drop like a bolt into the water and seize a silvery fish. Should there be a chance of failure, the bird will pull itself out of a nose dive in mid-air and continue its flight on an even keel

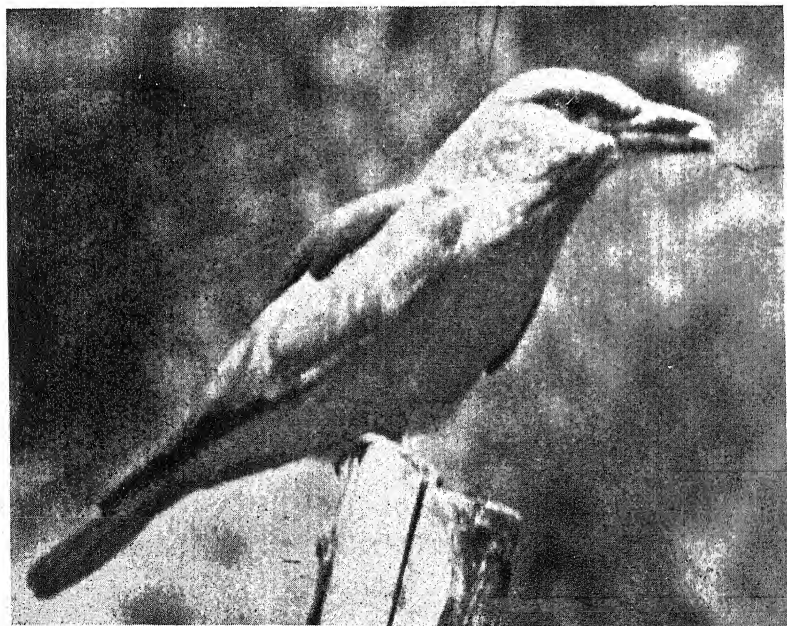




*The Common Central Asian Kingfisher.*



*The Indian Pied Kingfisher.*



until another shoal is sighted. It will then rise steeply and on hovering wings remain stationary, body upright, bill pointing to the water, until a lightning dive succeeds and is followed up by a picture of the bird flying off, a sprat in its bill, 'chirruk chirruking.'

On reaching a suitable perch the fish is battered about and finally swallowed head first, with a deft jerk into the air. The whole manoeuvre is most spectacular and quite unique.

Though shy of human beings, my distant release apparatus did not affect the birds in the least; in fact, on their first return to the nullah after the camera 'set-up' disturbance was over, one of the birds actually sat on the camouflaged basket covering the camera, while the other took to the perch that I had driven into the ground by the nesting hole.

After each exposure the necessary approach to the camera in order to re-set the shutter and turn on the film, disturbed the birds, but not more than ten minutes sufficed for their return with the possibility of a pair taking a seat on the focused perch.

### **The Kashmir Roller.** *Coracias garrula semenowi*.

With the coming of Spring, the arrival of this gorgeous bird brightens up the landscape.

The Roller is solidly built and has a heavy bill. When seated it appears as an ordinary light blue bird, about the size of a pigeon. It is not until it swoops from its perch that brilliant broad bands of Oxford and Cambridge blue on its wings show up in a delightful transformation. The bird is fairly common in the Vale, and I have seen a stray pair or two on the edge of the pine forests up to 8,000 ft.

From some elevated perch it watches for shrew, frog or anything that moves on the ground. Its swoop down to capture the morsel, the return flight to the post to devour it, are all colourful manoeuvres. The abandon of the nuptial display so frequent at this time of year, during which the bird rolls and tumbles about the air uttering its harsh and raucous cries, attracts constant attention.

Even at a later period of the season when the love display has passed and one of the pair is brooding eggs, the other remains alert and always on guard. Intolerant of trespass near the nesting hole it will swoop down with harsh grating screams at the intruder. These colourful performances can be seen throughout the bird's stay in Kashmir.

As I will never dig out a nest, it is difficult to say how deep their burrows extend into the earth, but judging by the many nesting cavities laid open to view in these banks every Spring, by erosion, I fancy the birds do not tunnel for more than roughly 6 to 9 inches before evacuating the roomy nesting chambers. The eggs are glossy white and spherical and number four to six to a clutch.

These birds do not readily take to a perch near the nesting hole. It is not a question of fear but a preference to fly direct to the nest implying an inadequate exposure to the lens. As most of



the nests tackled by me have been at an average height of 20 ft. above the nullah bed, a frontal 'set-up' for a 'close-up' picture is difficult.

However, very often a suitable perch, used by the birds before their final plunge into the nesting hole, can be found in the area, and by the exercise of a little patience, the camera will catch a number of good poses.

### **The Central Asian Kingfisher.** *Alcedo atthis pallasii*.

This little bird, a gem among birds, is the northern version of the Common Kingfisher. With its solid build, long bill and brilliant green blue and chestnut plumage it needs little description as it is the most familiar bird on the Lakes and waterways of Kashmir during the summer months. It literally foists itself on one from its penchant for perching in the open, a little above the surface of the water. The wires and posts used for anchoring houseboats are freely used. Here it will sit fearless of man and every now and again plunge obliquely into the water and return to the perch with a silvery fish in its bill. If unsuccessful in its attempt, it will fly swift and low over the water with a distinct, sharp roll of its little body, and utter a trilling note as it streaks away in search of a further suitable vantage-point.

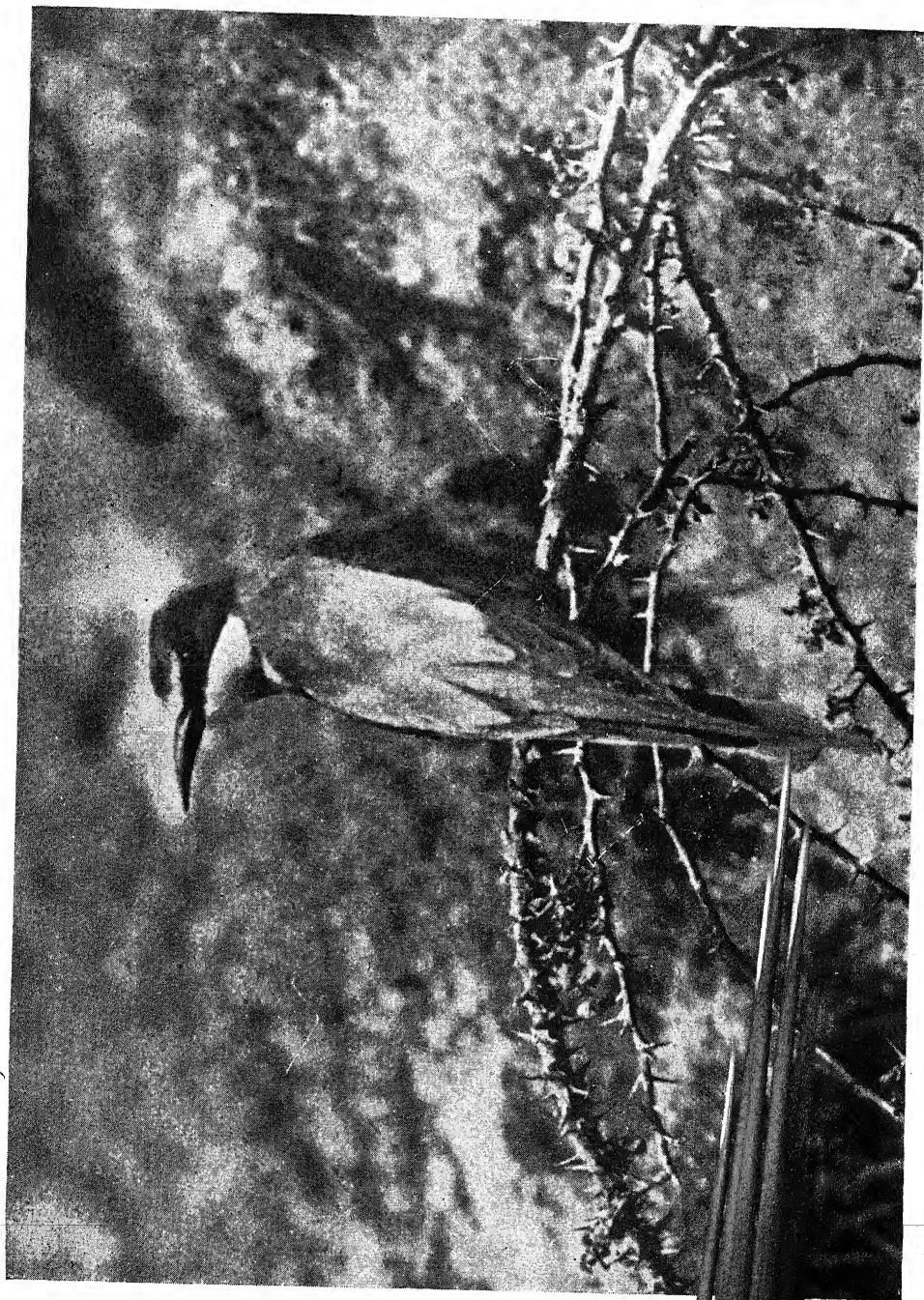
The normally accommodating gullet, stretched to its utmost by the outsize in fish presented, calls for a supreme effort on the part of the bird. A great struggle takes place, for with eyes closed, a frequent up and down movement of the head and its fanned tail flicking, the bird struggles to swallow its capture; but is little disturbed by the experience, for almost immediately the next minnow within reach pays for its carelessness.

Over open water it may be frequently seen hovering with body erect, bill pointing downwards, preparatory to plunging in after its prey.

The breeding season is very extended, the main months are April to June, but young fledglings have been seen as late as September.

The nesting tunnel excavated by the birds runs level for about three feet before the actual egg chamber is reached, where the six white eggs almost spherical in shape lie. A Kashmir village is a rose garden when compared with the stench and squalor connected with the abode and upbringing of such beautiful jewels of nature. A great number of these nests must be swamped out annually, either by heavy rain storms, or snows melting which cause a rise about a foot or so above the normal level gauged as sufficient by the birds when digging out their nests.

Having no fear of man and with a succession of favoured fishing posts for perches photography is easy. The first snapshot may portray a look of enquiry towards the camera, quickly followed by another showing the bird with bill lowered following in rapt attention movement in the water below and ready for a plunge into it, and then yet a third to complete the sequence, showing the return to the perch with a small fish held firmly in its bill. This sequence was actually taken by me from one of the living rooms in my houseboat.



*The European Bee-Eater.*



*The Rufous-backed Shrike.*



*The Common Sandpiper.*

**The Rufous-backed Shrike.** *Lanius schach erythronotus.*

This Shrike is 10 inches in length, its grey head, the broad broad black band running backwards across the forehead through the eyes, the long graduated tail and severely notched bill are features common to several members of this well marked family. In this species the rich rufous lower back and rump, and the rufous-tinged abdomen are distinctive.

This Shrike is one of the most common visitors to Kashmir in summer, arriving in early April and remaining till late in September. Its abundance may be gauged by the numbers inhabiting the popular avenues bordering most highways in the Vale and by the surplus living in the willow groves and frequenting gardens. The habit of sitting bolt upright on some bare twig with long tail swaying gently up and down, the constant lookout kept to help pacify an insatiable appetite, the sudden dash down to the ground to stab at its insect prey, the laboured flight return to the original perch, make these birds conspicuous.

I have never actually found the larder of this particular species, but they are bold robbers and to them eggs are a great delicacy. A friend of mine had the aggravating experience of seeing a Shrike pounce at, and destroy the eggs in the nest of a Paradise Flycatcher while he who busy setting up a 'hide' in preparation to photograph the owner.

The flight, though laboured at the start, is swift and straight propelled by extra rapid beats from wings that appear inadequate to carry the slender body and long tail. The call notes are a harsh and loud chattering but during the early spring and the incubation periods, the cock bird has a soft and musical song, well sustained, and with a variety of notes, but so subdued as to amount to mere mumblings. An irregular flirting of the wings always accompanies these efforts at song.

The nest is a massive, deep, untidy cup of assorted materials usually comfortably lined. The eggs, commonly five to a clutch, are a white or creamy ground colour sparsely spotted and blotched with shades of brown except for the distinct wreath formed round the broad end.

One nest found contained eight eggs, and from observations, these were brooded by the one pair of birds. There is every indication that at least two broods are raised during the breeding season. The bird is victimised by the Cuckoo. The nest, usually tucked away snugly at the junction of two stout branches, the bird's rapid succession of hops to it, immediately after alighting on the tree, and its quick disappearance into the deep nest cavity are the chief obstacles to successful snapshots.

**The Spotted Forktail.** *Enicurus maculatus.*

It was while motoring between Chenari and Hri on the Jhelum Valley Road, along the wide stretch of it which is carved out of the mass of frowning, damp, moss-covered rock deeply fissured at intervals by miniature waterfalls, that I met my first Forktails.

The loud uncanny screams from the surprised bird as it plunged across the road just ahead of the bonnet of the car were quite

startling in effect in such a wild spot. Wooded ravines holding fast mountain streams form their normal habitat.

At first sight this pied bird may be mistaken for a wagtail being roughly of that size, but on closer view, the deeply-forked long tail, gently swaying up and down, and the entire lack of hurried jerkiness in its gait emphasises the difference.

Its plumage blends well with its surroundings. The dappled pattern of white spots and lines become very obliterative in its mountain torrent home, where the shaded rocks and glittering spray tend to form a similar pattern. The large white patch on the forehead, and broad, white Y on the lower back are distinctive.

The nest is a compact and heavy cup composed mainly of green moss and clay and tucked away in a variety of places but always near rushing water. The eggs are greenish with brown spots evenly distributed over its surface.

The day after my successes in the Nullah Aviary, previously described, I was motoring to the Sind Valley and when passing the 12th milestone I was surprised to see of a Forktail feeding by the roadside in this open country miles from any ravine. This being my first real close-up of the bird, I followed its movements along the muddy drain where it was pecking its insect food, and being of a confiding disposition I was able to keep it in view along the undulating ground.

Excitement ran high, when it was joined by a second Forktail which without ado began to collect a billful of moss, with which it flew away towards the car.

My 'even time' chase soon brought me to a viewpoint overlooking the whole area, but too late to pin down the spot from which the bird had emerged. Its scream from further up the roadway indicated that it was returning to its original beat via the drain. A hurried search round revealed a surging mill-race, tumbling down over a fall in ground level about 10 ft. in depth. This appeared to me to be the only likely spot for a nest. I was about to rush back to a viewpoint which would enable me to watch both the birds and the fall, when both flew on to a fallen tree trunk, bills laden with moss. From here, each in turn, without delay flew through the cascade. On their exit the camera was hurriedly set up and I was able to get six exposures by hand from a distance of 15 ft. of the birds, as they alighted in the focused area preparatory to dashing through the water.

A bulky half built nest was found placed behind the curtain of foam on a small ledge of rock out of reach of the raging waters but made quite sodden by the misty spray.

The following year another Forktail's nest was found in similar open country. It was placed about a foot above a swift flowing canal, and as this site was not more than 3 miles away from the nest described above, it seemed indicative that the same pair had made this open country their abnormal haunt.

Some days are indeed red-lettered and this was one of them. The entirely unexpected meeting with the Forktail was to form but part of the day's gift. On reaching the rendezvous at milestone 14, the shikari was spotted sitting by the roadside opposite a quarry. He had spotted a brilliant blue Kingfisher fly into the



burrow. This proved to be the nesting hole of the White-breasted Kingfisher, a bird scarce at this height in Kashmir. It was to form the main item for the morrow's photography, as all likely perching places were at this time lost to sunlight.

**The White-breasted Kingfisher.** *Halcyon smyrnensis.*

It was considered a great piece of luck to have found a nest of this brilliant Kingfisher at this elevation in the Vale, as I had always thought that the single birds seen at odd times must be wanderers off their usual beat. Their sporadic appearance at all seasons of the year indicate that members of a new strain are preparing to become naturalized Kashmir Highlanders.

The bird is a little larger than the Myna, though its heavy pointed dull red bill exaggerates its size. The white breastplate set in a chocolate brown under plumage is pleasing but quiet in tone compared with the dazzling turquoise-blue of the upper plumage spreading from under the brown head and neck.

It is a noisy bird whose presence in any area can be detected at a distance. The harsh 'Kenk-kenk-kenk', a succession of three rapidly repeated notes, screamed whenever the bird takes to wing, carries and is unmistakable, as is also what is presumed to be the song, which takes the form of a long-drawn-out roll of smooth notes, ascending in scale and very plaintive in tone. This song is uttered by the bird, with bill pointing up to the heavens, from its perch on some bare branch in a tree.

The entrance shaft of the many nesting tunnels of this Kingfisher shows a tendency to being dug not horizontally but on an upwardly inclined plane for the first foot or so of its length. It was this distinctive tilt that, in those far off egg-collecting days, gave me sufficient grounds to cut out any qualms about snakes and to thrust my hand without hesitation into the hole to get at the egg chamber. The golden rule followed in those days was that a hole running horizontally or downwards was not to be handled owing to the danger of its harbouring snakes, but visual evidence (fortunately) has since proved the folly of rash youthful wisdom. The fairly spacious egg chamber has never been found to contain evil smelling debris as is the case with its miniature relative. This apparent cleanliness may be the outcome of the difference in diet, as, during this session, the picturing of a pair of birds busy feeding well-grown fledglings, revealed that not on a single occasion did a parent bird bring fish to the feast but always frogs or the battered remains of lizards. The eggs are typical of the family being glossy white and almost spherical.

Two vivid memories of this bird in the Plains will always remain. On the first occasion, I was fortunate at finding myself witness at the start of nest-digging operations. The birds were seen following each other in quick succession, jabbing at a spot in the sandy bank. Then a circular indentation about three inches in diameter became visible affording the birds a bare purchase to enable them to continue digging. In clinging to that minute ledge, the little crimson legs had to be aided by pressure on the bank from outstretched wings. This was a picture that cannot

be erased from my mind. The brilliant turquoise-blue against the sandy background was enhanced by the bright rays of a sun, low on the horizon. It gave a dazzling effect to an already delightful picture.

The second indelible instance savoured more of a timely warning. I had taken an egg collecting friend to a nest with the intention of giving him the clutch of eggs. On arrival at the site, a very agitated kingfisher was seen thrusting at the nesting hole with much '*Kenk-kenk-kenking*'. Shortly afterwards to our very great surprise, a snake made a quick exit from the hole, fiercely attacked by the brave bird. The snake was not less than five feet in length and may have been a '*Dharmman*'—a harmless rat snake, but both of us could not be sure that it was not a deadly Cobra. My present pursuit—photography and the entire lack of temptation to harm a feather—undoubtedly brings sundry awards in its train.

At long last, after an exciting week of photography by the wayside, the beautiful Sind Valley was reached at a point where it broadens out into the Vale. Its confined waters still swirling over the boulder-strewn bed at Woyil Bridge soon continue in a more placid strain to their junction with the River Jhelum in the neighbourhood of Shadipur. In the immediate vicinity of the Bridge are seen the many sandy, boulder-strewn islands made by the subsidiary overflows from the main stream which cut through the low lying ground bordering its northern banks. Much could be written about the wild grandeur of the upper reaches where steep cliffs and menacing gorges are lapped by its angry waters; but it must suffice here to give but an introduction to these boulder-strewn islands. They are the summer home of the Common Sandpiper, Jedron's Little Ring Plover and Hodgson's Pied Wagtail, the only water birds among others to be described here, as June provides the peak for their breeding activities. Two others, the Brown Dipper, and the Ibisbill, have been described elsewhere as they are early breeders. The Dipper launches its speckled young when the Ibisbill is about to brood a fresh clutch of eggs during the first week in April.

All the birds mentioned in this chapter can be seen and watched, year in and year out, from the main road, or at most within a half mile of it. There are three notable omissions, Pallas's Fishing Eagle, with its gigantic platform nest perched on the top of a Chenar, with its trunk severed at a height of about ninety feet, and the Grey and Night Herons who still colonise the same heronry in the lofty heights of a grove of Chenars which have been used for generations by them.

Time and again have I fought against the wise promptings that danger to life and limb weighed far too much in the scales against an attempt to photograph these birds at such dizzy heights, and so far these councils have prevailed, and no pictures have materialised. These promptings have nevertheless produced envious thoughts at the remarkable efforts of that intrepid bird photographer, E.H.N.L., who with his combination of brain and brawn knows no ceiling and thus successfully portrays subjects at incredible heights above ground level.

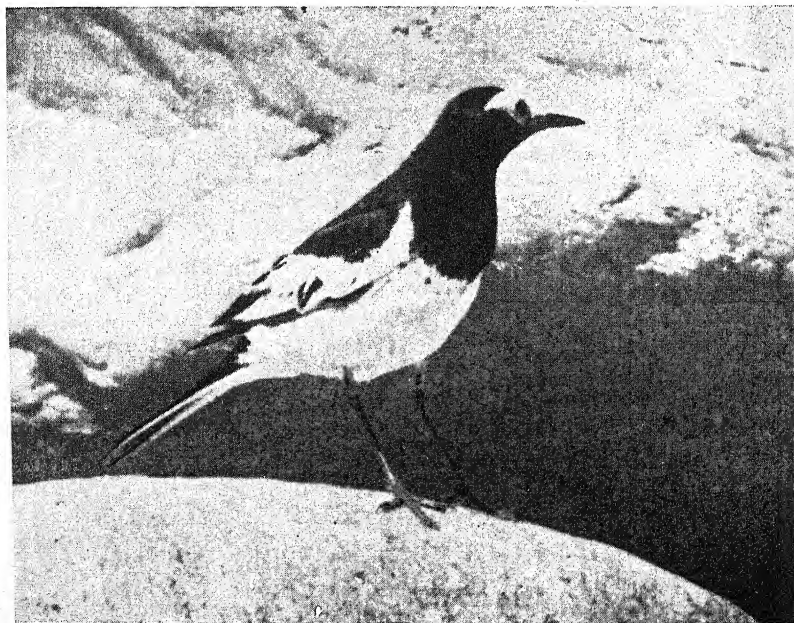


*The Western Spotted Forktail.*





*Jerdon's Little Ringed Plover.*



*Hodgson's Pied Wagtail.*

**The Common Sandpiper.** *Actitis hypoleucos.*

Being a summer visitor and breeding in Kashmir, this quietly dressed attractive bird, not larger than a Bulbul, is constantly seen and heard on most of the mountain streams. The plumage is olive brown above and on the breast, and white underneath.

It is a very active bird seen tripping along the margins of streams pecking up its minute food, or in quick flight low over the water uttering its shrill pipings. The flight is curious, as the upper part of the wings are held in line with the body apparently motionless, the powerful propelling force coming from the rapid downward beats from below the elbow.

The call mainly heard during the bird's visits to Kashmir has been so ably sounded by Whistler 'Kitty-needie, Kitty-needie, Kitty-needie'—this appears to be an emotional love song, and is more in evidence than the normal shrill piping notes used when on the wing.

Many 'eternal triangle' scenes are witnessed at this season, and how universal is the guile practised by the fair sex. One, betrothed, will show keen interest in a newly alighted beau, who with wings raised vertically above the head will proclaim his presence with a pretty Kitty-needie, Kitty-needie, Kitty-needie, and look his best doing so. This play, however, is of short duration for the new intrigue is snapped in the bud, by the hasty arrival of the rightful owner who hustles away his erring spouse.

The nest is usually placed on the ground under a low tamerisk bush, or some other vegetation growing on these islands. Some are sketchy affairs with little grass, others more solidly built. The eggs are four in number, pear-shaped, and lie in the usual 'Wader' fashion, sharp ends pointing to the centre of the nest. They have a buff ground spotted and clouded with shades of red-dish-brown. It is of interest to note that a nest of this species was found with full clutch up in Gulmarg 9,000 ft., which was successfully hatched out in July.

The bird is a very difficult subject to photograph, except when seated on the nest, owing to its rapid movements, even when standing, its continual sharp nodding of the head and flirting of the tail. Further, even if a high viewpoint overcomes the faulty guesses concerning its entry into the focused area, its aggravating habit of tripping along, at breakneck speed, while crossing the last yard or two to the nest, is too much for even a 1/500 second exposure.

**Jerdon's Little Ringed Plover.** *Charadrius dubius.*

This tiny plover, no bigger than a sparrow, is a summer migrant and delightful to watch. The plumage is sandy-brown above and white beneath, with black bands across the forehead and round the neck. An additional broad black gorget spans the breast.

The plaintive whistle will probably first attract attention. Then the bird's swift wheeling flight—a rapid beat of sharply pointed wings. On the ground it dashes along the sand with legs twink-

ling so fast as to become invisible, its rapid spurts are punctuated by short pauses to seize its prey with a curious hinged to knee-joint tilt of the body. Further spurts and pauses follow. In spite of its untiring activity, the bird is difficult to keep in sight, as its whole make-up tends to obliterate the contours of its body.

There are two distinct types of nesting sites in the Vale, the small scrape is made either on sandy pebbled ground, or in clay in the middle of bog. The curious haphazard laying of two or three blades of grass across the scrape appears to be common to most nests. The nests being placed in the open, suffer much from the hoofs of wandering cattle.

The four eggs, in common with those of most waders, are very large in size and pear-shaped. The buff or greenish ground spotted with brown produces a very protective design.

Thanks to the habit of constantly pausing between runs, the bird is a very easy subject to photograph in most of its characteristic attitudes.

### **Hodgson's Pied Wagtail.** *Motacilla lugubris alboides.*

This is a very common and friendly bird found in numbers in summer on the Kashmir streams where it breeds profusely. It is of slight build and elegant, the male looking dainty in his black and white, and only differing from the female in the colouring on the back, which is grey in the latter.

These slender birds are pleasing to watch, for they are seldom seen at rest but always with the tail wagging non-stop, much to the detriment of photography. It chases its insect prey at great speed along the ground and seldom grants reprieve to an insect endeavouring to get away on wing—for the bird sallies after it in the air and having completed its mission returns to land, emphasising the success by much more tail-wagging.

The flight is also very noticeable for it is accompanied by a cheerful 'chezzit' uttered usually during the downward swoops in its series of regular undulations in the air. During the breeding season the male bird has a powerful call and is also often heard soliloquising in a medley of soft notes, pleasing in rhythm.

The normal nesting site is among rocks, but in Srinagar a pair once commenced to build on my houseboat and continued to do so throughout its twenty-mile move upstream. The birds appeared to be quite undisturbed, flying off to the shore and returning to the moving boat with further material for the nest. The comparative few that inhabit Gulmarg, almost without exception, desert the banks of the streams and prefer to complete nidification under a friendly and accommodating roof. The nest is of grass or other similar material with the cup-shaped interior neatly lined with hair or wool. Five appears to be the normal number of eggs found. They are of a light grey shade profusely covered by tiny spots of brown.

A great deal of keen interest is aroused for the bird watcher in the Vale of Kashmir in his efforts to prove or disprove opinion of

authorities regarding the breeding of two closely allied species of White Wagtail.

Although the general consensus of opinion is, that Hodgson's is the only species breeding within Indian Empire limits, yet one authority claims that the Masked Wagtail also breeds commonly in Kashmir. The striking similarity shown by the males of four species of this family and their presence in numbers all over India during the winter months urges one to centre interest on each bird in the legions of pied Wagtails seen here during the breeding season. Up-to-date I have never found a nest of the Masked Wagtail, in spite of hopes often raised by the appearance of a wagtail, which may prove to be the Masked Wagtail, in an area where another female wagtail was brooding her eggs. This keys up one's hopes to the possibility that the newly alighted grey-backed bird might be its male owner and thus give sufficient proof that the nest was indeed that of the Masked Wagtail. Time and again these hopes have been dashed to the ground by the casual arrival at the nest of the male Hodgson's, proving that newcomer was not the rightful owner of the nest, but possibly another stray Hodgson's female. The close resemblance between the male Masked Wagtail and Hodgson's female makes such supposition possible.

ON PESCHETIUS GUIGNOT (COL., DYTISCIDAE) WITH A  
DESCRIPTION OF A NEW SPECIES FROM INDIA.

BY

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Peschetius Guignot (1935).

Guignot, 1935, Rev. franç. Ent., 2, 131.

This genus was erected to include the Indian species, *Hydroporus quadricostatus* Aubé, and the two African species, *Hydroporus carinipennis* Régimbart and *nodieri* Régimbart. Unfortunately Guignot omitted to cite a genotype and by so doing technically invalidated his creation of the genus according to Article 25 as amended at the International Zoological Congress in Budapest, 1927. The genus is certainly to be accepted as distinct and I hereby cite *Hydroporus quadricostatus* Aubé as genotype in order to give it validity.

The generic characters adduced, in the first place by Peschet (Voy. Guy Babault en Afr. or. angl., 1921, 14-15), are:—Coxal lines cariniform, limiting between them a deep depression, wide in the middle; first ventrite with large deep foveoles to the number of two or three in *carinipennis* Rég. and *nodieri* Rég. and from six to seven in *quadricostatus* Aubé; second and third ventrites

fused, the suture separating them only barely visible laterally; second ventrite on either side of the middle line with a deep semicircular impression serving as cavity for the trochanter and base of femur of hind legs; third ventrite sub-rectiform, strongly elevated at the apex; three terminal ventrites seen laterally not on the same plane as the three anterior.' To these are added by Guignot:—'First antennal segment much longer than the second, the epipleurs reaching the apex of the elytra.'

The force of the characters listed above is by no means uniform and the two characters suggested by Guignot, the second being strongly stressed by him, do not appear to me to advance the principal character mentioned by Peschet—the unusual coxal lines—since certain species of *Deronectes* s. str.—*bicosatus* Schaum—have the basal segment of the antennae distinctly longer than the second and the epipleurs cannot be said to attain the apex (sommel) of the elytra to a greater extent than some *Deronectes*.

Two further characters not mentioned by either author appear to me to be of primary importance, viz.:—the ridge on the inner face of the elytra terminates in a distinct waved or double ligula and at the base also develops a distinct lobe; the hind coxae are much more developed than in *Deronectes*, the metasternal wing being distinctly arched and of an almost uniform thickness nearly up to the apex. Neither of these characters is to be found in any group of *Deronectes* and to them may be added the total absence of a true pronotal margin, a state almost reached by some species of the compared genus although in all of them a distinct trace remains near the anterior angles. A further feature is seen in the unusual course of the true elytral margin near the shoulder where it dips down very sharply so that the epipleur appears to be very nearly parallel-sided to the level of the first ventrite, a structure entirely peculiar to the genus among the *Hydrophilinae*. It also deserves comment that the epipleurs are throughout coarsely punctured; the hind femora impunctate; the hind tibiae have two longitudinal rows of piliferous punctures on the infero-external face, the rest of the surface being reticulate, impunctate; and that the spurs of the hind tibiae are unequal.

Guignot suggests that the genus should be placed near *Antiporus* and *Macroporus*, chiefly on the character of the epipleurs. Although, as I have shewn, the force of the character of the epipleurs is not very great it does appear that the genus is best placed between *Antiporus* and *Necterosoma*, with each of which it has many affinities. The following new species is to be added to the three already included:—

*Peschetius andrewesi* sp. n.

(*Deronectes andrewesi* Régimbart in coll.)

(*Deronectes belli* Régimbart in coll.)

Elongate-oval, subdepressed, rufo-ferrugineous; head broadly black from the posterior margin of the eyes almost to the anterior margin of the fronto-clypeus, the vertex rufo-ferrugineous; frons moderately densely and shallowly, coarsely punctured, the interstices of the punctation about equal to the diameter of the punctures, more or less obsoletely microreticulate, the punctures gradually decreasing in size and somewhat sparser towards the anterior margin; on either side with a large shallow fronto-clypeal depression; vertex strongly, almost shagrinately microreticulate, the meshes absolutely regular, impunctate. *Antennae* long, the basal segment at least as long as the two following taken together, the fifth, sixth and seventh segments also rather elongate, sub-equal, rufo-flavous. *Pronotum* transverse, the sides widely rounded, quite unmarginated, with a shallow longitudinal impression on each side, well separated from the edge and a sub-basal transverse impression connecting on either side with the longitudinal impressions, posterior angles slightly obtuse; closely, regularly and uniformly punctured, the punctures separated by about their diameters, the interstices dull microreticulate; rufo-ferrugineous, a small black basal mark on either side of the middle line; scutellar lobe very slightly developed, the hind margin being only slightly rounded in the scutellar region; prosternal process large, strongly laterally compressed, strongly rounded, not carinate tectiform (c.f. *quadricostatus* Aubé), the apex bluntly rounded, lateral margins obsolete; intercoxal piece of the prosternum without a transverse step or rugae. *Elytra* elongate-oval, sides very slightly rounded and widened to the middle, widely

rounded posteriorly, weakly acuminate at the apex; as wide basally as the base of the pronotum but the angle of junction of margin with the edge of the pronotum very pronounced owing to the abrupt upward curve of the epipleural margin; two longitudinal costae, the inner straight and commencing directly behind the base of the elytra and attaining to four-fifths of their length, the outer one beginning some distance behind the shoulder and running almost parallel to the inner one for three-quarters of its length and then widely rounded convergent to join the inner costa at its apex; margin abruptly curved upwards at the shoulder; epipleurs and dorsum punctured and sculptured as on the pronotum; rufo-ferrugineous with the black pattern common to all the species of the genus. *Venter* rufo-ferrugineous, the edge of the hind coxae and abdominal ventrites infusate; metasternum and hind coxae sculptured as on the dorsum, the impression between the coxal lines almost impunctate, shining; basal abdominal ventrite with seven to eight shallow oval, sharply impressed foveae on either side of the middle line, their cavities microreticulate; second and third ventrites fused, the second with five similar foveae and numerous large punctures on either side of the middle line, the middle line rather pinched, almost carinate at the base; sixth ventrite dull, microreticulate, the edge strongly, the disc very finely punctate (c.f. *quadricostatus* Aubé). *Legs* moderately long, the tarsi of the male slightly more dilated than in the female on the anterior and intermediate legs, fourth segment small but distinct, fifth quite elongate, as long as the second and third segments taken together; claws simple in both sexes.

*Type*.—India: Nilgiri Hills (H. L. Andrews coll.). (*Deronectes andrewesi*. Reg. n. sp. typ., Regimbart det.). *Paratypes*.—3 specimens, same particulars as type. 2 specimens, S. India: B.M. 61-20—Coimbatore, Koondah Hills or Nilgiri Hills (M. J. Walhouse coll.). 2 specimens, India: (without further particulars), (B.M. 67-56, ex coll. Hamlet Clark.). 6 specimens, India: Khandesh (T. R. Bell coll., ex coll. H. L. Andrews), (*Deronectes belli* Reg. n. sp. typ., Regimbart det.). 1 specimen, India: Igatpuri, 2,000 ft. (ex coll. H. L. Andrews).

*Size*.—2.9-3.35 mm. long, 1.5-1.6 mm. lat.

(All specimens are in the British Museum.)

This new species is very similar to the three already described. It may easily be distinguished from *quadricostatus* (Aubé) by the black fronto-clypeus and the dull, microreticulate, much more finely punctured sixth ventrite. From the two African species it may be separated by the greater number of foveae on the first ventrite, and from *nodieri* (Rég.) it is further separated by the black fronto-clypeus whilst *carinipennis* (Rég.) lacks the post-humeral extension of the sub-nasal black band to the margin, possessing instead a longitudinal band along the outer edge of the inner carina which joins the discal black band.

The lateral lobes (parameres) of the aedeagus are of a form unusual in the *Hydroporinae*, in which they are frequently hooked at the apex. In *Peschetius* they are terminated by a weakly inflated elongate rounded lobe provided with numerous long hairs along the inner face, a type normally found in the *Colymbetinae*. The significance of this character in a group otherwise indubitably *Hydroporine* is not as yet apparent.

I am unable to find any distinctions between *andrewesi* and *belli* (Rég. i. 1) and dissection has shewn the aedeagus to be identical and accordingly I have adopted the former name for the species.

MICRODYTES GEN. NOV. DYTISCIDARUM  
(HYPHYDRINI).

BY

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*Microdytes* gen. nov.

*Head* transverse, eyes quite small; anterior edge of the fronto-clypeus without a trace of a raised or produced rim, the apex transverse, not rounded, labrum visibly exerted, emarginate in the middle. *Pronotum* transverse, sides narrowly margined; base at middle distinctly, but not largely, roundly produced; prosternum extremely small in front of the anterior coxae; prosternal process small, lanceolate-lobate, the apex rounded, not acuminate, transversely weakly convex, the sides margined at base. *Elytra* widely rounded, the inner face with lamina expanded into a prominent ligula at the apex; epipleurs at shoulder with a 'bordered pit'. *Venter*: Meso-coxae distinctly separated; mesosternal fork very minute but distinctly attaining the intercoxal process of the metasternum which is shallowly, roundly grooved. Metacoxae very large, the anterior margin strongly arched, the posterior soldered to the anterior margin of the first abdominal ventrite; metacoxal processes adpressed; base of the trochanter completely exposed, the articular cavities distinctly separated; coxal lines terminating at the articular angle, not turned inwards and prolonged; metasternal wings very narrow and strongly arched; sutures of second and third ventrite completely obsolete. *Legs*: hind tibiae on the infero-external face with two longitudinal series of spiculiferous punctures, the upper series not set in a distinct groove obliquely; segments, particularly the basal one, simple, without a weak but distinct longitudinal dorsal ridge, reticulation obsolete; hind tarsal claws unequal but the shorter one quite distinct and about two-thirds the length of the longer one.

Genotype.—*Microdytes belli* (Rég. i. l.) n. sp.

This new genus is a member of the tribe *Hyphydrini* and is very close to *Desmopachria*, from which it is not easy to separate it, but it is undoubtedly a distinct genus on the slight but constant differences, e.g. truncate and unmargined anterior edge of the fronto-clypeus with a more visibly exerted labrum, slightly different course of the coxal lines, shorter trochanters, presence of two linear series of spiculiferous punctures on the infero-external face of the hind tibiae, the upper series not set in an oblique groove, the absence of the median longitudinal ridge of the dorsal surface on, at least, the basal segment of the hind tarsi, and the longer outer (lower) claw of the hind legs.

It is possible that *Hydrovatus maculatus* Motschulsky (*Etud. Ent.*, 8, 1859, 42), re-described by Régimbart (Ann. Soc. ent. France, 68, 1899, 231) and transferred to *Desmopachria* by Gschwendtner (Rec. Ins. Mus., 37, 1935, ?) may belong to this genus, but no description I have seen deals with the course of the coxal lines, the punctures of the hind tibiae or the characters of the hind tarsi and tarsal claws. Until an authentic specimen of that species can be examined for these characters its position must remain doubtful.

*Microdytes belli* (Rég. i. l.) n. sp.

*Head*: rufo-ferrugineous, very finely but quite copiously punctured, the interstices four to five times the diameter of the punctures, quite shining and without a trace of reticulation except along the anterior edge of the fronto-clypeus where an extremely fine and lightly incised meshwork can just be seen. *Antennae*: rather short and slender, the anterior edge very slightly serrate, the first and second segments subequal in length and width, the second as long as the third and fourth taken together, the fourth very short, as wide as long. *Thorax*: pronotum fusco-castaneous, the anterior, posterior and lateral margins narrowly paler; the sides finely but distinctly margined, the posterior angles



almost acute but not at all produced; the scutellar lobe very shortly roundly produced; the surface strongly shining, regularly, more strongly than on the head and rather more copiously punctured, the punctures three times the size of those on the head and the interstices two to three times the diameter of the punctures; prosternum exceptionally narrow in front of the pro-coxae, the prosternal process small, lanceolate-lobate, terminally rounded, weakly convex, the sides distinctly margined at the base; anterior tarsi four segmented, laterally compressed, the claws simple and equal. Metasternum and metacoxae with the sutures almost obsolete, highly polished, rather coarsely, regularly and evenly punctured on the coxae, the sternum antero-laterally coarsely, posteriorly finely punctured, fusco-castaneous, the coxal processes rufescent; hind femora not at all inflated; hind tibiae not much narrower at base than at apex; calcaria stout, unequal, simple, the longer as long as the basal segment of the hind tarsi; the hind trochanters shorter than the posterior edge of their femora from the apex of the trochanter to the 'knee'. *Elytra*: regularly ovate, the sides dilated just behind the shoulder, the apex strongly rounded, not at all acuminate; giving the insect an almost rhomboidal outline; fusco- or nigro-castaneous with a broad transverse basal fascia dilated at the shoulder and continuing moderately widely along the margin to just before the apex with a confluent spot or enlargement laterally behind the middle and a second anteapically, a small round post-median spot near the suture, flavous, the surface highly polished and shining, punctured as on the pronotum but laterally more sparingly with the 'systematic' serial punctures almost or quite obsolete. *Abdominal* ventrites very highly polished and shining, the basal segment laterally with a few obsolete large punctures and some also on the second segment, the rest of the surface, even of the sixth ventrite, quite impunctate.

Size.—1.83-1.86 mm. long., 1.29-1.32 mm. lat.

Type.—India: Bombay Pres., Khandesh (T. R. Bell coll., ex coll. H. L. Andrewes).

Paratype.—1 specimen, same particulars.

(Both specimens are in the British Museum.)

Both specimens appear to be female, by comparison with *Microdytes championi* n. sp., described below, assuming the sexual characters to be the same for both species.

#### *Microdytes championi* n. sp.

*Head*: flavo-testaceous to rufo-flavous, finely, slightly, irregularly but fairly copiously punctured, anteriorly finely microreticulate but shining, the vertex strongly shining and without a trace of reticulation, the punctures here slightly larger. *Antennae*: as in *belli* n. sp. *Thorax*: pronotum flavo-testaceous to rufo-castaneous, the anterior edge narrowly infusate, the posterior edge more widely obscurely infusate in the middle, the sides finely margined, the margin black, the posterior angles almost acute but not at all produced; fairly copiously punctured, the punctures irregular, those on the disc finer, along the posterior edge coarser and a transverse band of almost equidistant larger punctures along the anterior margin, laterally the discal punctures become obsolete and the larger punctures reduced in size; prosternum as in *belli* sp. n. Metasternum and meta-coxae as in *belli* but the punctures much sparser and less regular; legs as in *belli*. *Elytra*: regularly oval, widest almost at middle, the sides evenly rounded, the apex more roundly attenuate than in *belli* but not at all acuminate behind, the form more elongate-rhomboidal than *belli*; flavo-testaceous, the anterior and sutral margins black or blackish and a fusco-rufous or dark castaneous broad, transverse, anteriorly waved band on the disc which does not attain the declivous portion of the side of the elytra, posteriorly the band is sinuous with a linear posterior extension on the disc terminating ante-apically in a rounded spot, the surface finely and fairly copiously punctured near the suture, progressively slightly more sparsely towards the sides, the 'systematic' series of punctures distinct, particularly the inner one, almost to the apex, the interstices of the punctation highly polished and shining. *Abdominal* ventrites highly polished and shining, the basal and fused second and third ventrites with a moderately copious fine punctation towards the sides, the sixth ventrite excessively finely and rather sparsely punctate, the surface highly polished and shining.



Size.—1.86-2.07 mm. long., 1.29-1.42 mm. lat.

Type.—India: United Provinces; Kumaon, Haldwani Dist., ♂ (*H. G. Champion* coll.).

Paratypes.—same particulars, 54 specimens.

(The type and 32 paratypes in the British Museum, the remainder in coll. (*Champion*)).

This species is readily distinguished from *belli* by the colour, the greater extent of the reticulation on the head, the distinct systematic series of the elytra, the sparser metacoxal and more plentiful, finer punctures of the basal abdominal ventrites. The only apparent secondary sexual character is seen on the lobes of the labial mentum where the male has a dense tuft of long golden hairs, the female having this part glabrous. This is a very unusual secondary sexual character of the Dytiscidae and no similar case is known to me.

## SOME REMINISCENCES OF SPORT IN ASSAM.

BY

H.G.H.M.

### Part IV

Along the base of the Bhutan Hills is an extensive Game Sanctuary from which tigers find their way to other dense jungles which are a natural sanctuary and in which they cannot be attacked until they roam further afield into the more open grass jungles bordering on cultivated areas. Then they become cattle lifters and so expose themselves to sportsmen; but it is only with the aid of elephants that they can be successfully dealt with.

On a cold weather morning in early March, on alighting from the train on the Eastern Bengal Railway at the wayside station of Sarupeta in Assam, it was a fine sight to see some fifty elephants lined up to meet the guests of the always hospitable Rajah of G. Soon we were all sorted out and seated in our howdahs. The programme was to beat through the jungle towards camp about seven miles away, and there was hope of tiger being seen as there had recently been 'kills' in that area; but we had no success.

The next day we started out fairly early, and though there was no 'khubber' of a kill, the beating line, after a deal of hard work, put up a tigress with small cubs and of course, as usually happens in such cases, she charged the line not only once, but twice, and the Raj Kumar, who was with the beating elephants stopped her by firing shots though she could not be seen. Eventually she left the cubs and was with considerable difficulty driven to the Maharajah of M. Several of the other guns could have shot her but the order was that she should be killed by the Maharajah; and so she was, with one well aimed shot. Returning to where the cubs were last seen, after much searching, in which the elephant's aid was invaluable, we found two of the snarling little creatures, the size of foxterriers. Secured by the mahouts who threw blankets over them they were deposited, in cane cages which

were always taken out on these big shoots on one of the pad elephants.

Although so recently caught, it was not long after they had been in camp that they permitted friendly patting of the head. In many parts of India it is not considered proper to shoot tigresses with small cubs, but in those enormous jungles teeming with wild animals of every description that was not the custom. All this caused much delay, so there was no more shikar, the Rajah having rightly insisted that as the mother had been killed her cubs should be found.

On the following day the Maharajah of M. was obliged to leave the camp and we had no success until after lunch when we found ourselves near the place where, the previous year we had killed six tigers in less than an hour. I had intended to take photographs but was told a tiger must be shot by me so I was posted where the tigers, if any in this promising cover, would be most likely to break. The Rajah made his usual very careful arrangements, posting each howdah elephant himself, and walking his elephant up and down behind the line, which was placed at right angles to the beating line, so that it would be safe to fire straight ahead. My position was away to the right front of the line at a spot where the tigers, having been driven from heavy jungle through light jungle, would naturally take again to the heavy cover in front of them. Orders to the line of howdah guns were that no shot was to be fired unless the tigers attempted to break through them to gain the heavy cover behind. I realized that it was quite likely the tigers, finding me in their way of retreat, would charge my elephant and was prepared for this.

Now the beating line was set in motion, and before long it was signalled that there were three tigers in front of it. These turned out to be a tigress with two three-quarter grown cubs. The tigress moved as expected, while the other two came along nearer the line of howdah elephants and were clearly seen as they made their way through the light jungle. When nearing me the tigress suddenly discovered the presence of my elephant, grunted and charged. I waited until she was close, and as the bead marked a point between her shoulders, I pulled the trigger and missed! Doubtless it was the common error of seeing the foresight and not the backsight also, so the bullet went high. She stopped, immediately jumped back, and ran into the jungle she had come from and was seen and missed by some of the other guns. Barely had the mother gone, when the two cubs were almost into my elephant's legs. Quickly they turned back and I feared to fire towards the now approaching line of beaters. One of the cubs, followed up by a member of the party, presented an easy shot and was killed. It was getting late so a beat for the tigress and other cub had to be quickly arranged. A narrow strip of jungle was broken down by the many elephants available—there were not far short of a hundred, as the Maharaja of M. had left his beasts although he himself had been obliged to go to Calcutta. The beat was now turned right about to force the hunted animals across the narrow cleared strip to the waiting guns on the further side. These were—from right to left, M. Junior, the Second

Kumar, quite a youth, myself and the Kumar: four guns. Behind us was the thick jungle and before us the imposing line of beating elephants. Away to our right were the surplus elephants which had trodden down the clear space, with the Rajah of G. and other guests.

First arrived the cub which received one bullet from the Raj Kumar's .500 rifle loaded with Low Pressure cordite cartridge having a 440 grain soft nose bullet; such a combination is very good for close shots afforded in howdah shooting. The Raj Kumar had only just reloaded when the tigress, now in very savage mood, sprang at his elephant's head but the spring was avoided by a rapid twist and the Raj Kumar, missing her in the air, gave her a second shot as she landed on the ground. This she answered with a grunt and sprang growling savagely into the grass. The younger Kumar was now ordered out of the jungle as it was not safe for him to take part in the approaching scrimmage. He was using a .400 black powder rifle taking a 230 grain bullet and 80 grains powder. This weapon is not good enough for a fighting tigress but I have seen the boy kill more than a dozen tigers with it, one shot apiece. One of them, shot in the chest, measured ten feet, a very heavy male.

The Raj Kumar and I closed our elephants on the tigress. She charged again and was received with two hits, this time again retreating. Three beater elephants were moved up to push the tigress out and she charged one of them, getting astride the tusks of a big elephant named Urthumpersad. He went round and round like a top in the grass in attempting to throw her off, the two other elephants close by doing the same. During this it was not possible to shoot, and when at last the tigress was dislodged she charged the Raj Kumar who settled her with two shots. A fine beast she was, measuring nine feet.

It was this Urthumpersad which had been ordered by the Assam Government to be shot, but which had been bought by the Rajah of G. He was then exceedingly timid, but tigers have now been shot from his back and he will likely turn out an excellent howdah elephant, the result of expert training and management. Mrs. S, who knew all the Forest Department elephants at Kochugaon will be interested to know this, should she come across these reminiscences. We padded the three tigers and returned to camp. Even this day's sport showed that tiger shooting from elephants is not always a tame affair.

The following day only one tiger was shot and this fell to the Second Kumar and his light rifle. The bullet mushroomed perfectly. The day after that, the 11th March, five tigers were bagged. On this day it was again wished by our host that I should kill a tiger. The beat had just started and I was arguing with G's Doctor, who was in the back seat of the howdah, as to the possibility of a charge. He was saying that tigers, on hearing the advance of the beating elephants move to the edge of the cover, and if they do not detect the waiting howdah elephant move off to the next jungle in a very silent manner; also he was insisting that they often break back before the shikaris think they do, and that the tiger may be even now at the expected exit place—when

out the beast jumped with a grunt! I was taken by surprise and missed, the result of want of proper attention to the matter in hand. Never must one's mind be diverted for an instant or such chances will be lost. The tiger for some unaccountable reason ran into the open and was twice fired at by other guns, but went on as if untouched. Then the Rajah fired and it dropped to the shot and rolled into the cover on the edge of which it was at the moment. The Raj Kumar, who was further ahead, saw some movement in the high grass and a couple of elephants were sent to push through the cover: shortly a tiger showed in the nala close to where the wounded one had disappeared. G. fired and it jumped into the grass and died. All movement having ceased an elephant was sent in to investigate and to the surprise of everyone, the mahout announced 'two dead tigers'. When the bullets were recovered from the bodies it was found that besides the .465 used by the Rajah there was a 12 gauge Paradox conical bullet from the weapon used by M. Junior. This had been fired at a range of about 75 yards and had had no effect, though well placed. The beast had not even acknowledged the hit. Fifty years ago the Paradox, and other imitations of the idea, had a great vogue, but experienced sportsmen placed not much reliance on them except for close shots. I have seen a tiger, hit in the chest with one of these heavy conical bullets at close range, roll over but get up and move on as if unwounded. It was killed by another gun who does not know to this day that he shot a previously wounded animal. The good sportsman who used the Paradox did not claim the beast as the other man had never shot a tiger. After this we moved on and came to a place where four tigers were found. The tigress and her three nearly full grown cubs were at one time bolting all over the place in the light cover, and nearly everyone had a shot at them, but all without success. Another beat was arranged and in this I knocked over the tigress with my .280, rather an over-long shot. She got up and charged the beating line but was killed by one of the howdah guns. One of the large cubs, they were about eight feet long, was shot by M. Senior as it charged past his elephant, and another was killed by the Rajah with a charge of No. 4 shot from his gun. He leaned over the side of his howdah and it fell dead, the skull smashed to a pulp. The cub which had escaped killed a cow that night and was shot next day. On the 14th the elephants were given a rest, and then there was news of a man-eating tiger, and several others, in a certain locality. An early start was made as the distance was considerable.

#### *Death of a man-eater.*

The hut from which the man had been taken was situated very close to heavy jungle. It was still occupied, in spite of this having been about the twelfth or fourteenth man taken from the neighbouring village. The people are fatalists and say that when a man is taken by a tiger—it is his fate, and do nothing to save themselves from a similar doom. This tiger had killed a cow that very morning and dragged it into cover near a stream. The ground on both sides of the stream, as well as the stream itself, was very

boggy. Two of the elephants got badly bogged and had to be assisted out by others. Had there not been plenty of help available it is quite likely these two animals would have perished. Eventually all the elephants crossed the place, but four or five had to be left behind as they were quite exhausted. Here is another reason why this form of shikar is dangerous at times.

It is not often that elephants fall, they are so careful and cautious, but once my wife and I were in great danger our elephant put her right fore foot into a deep hole in the ground. We were all thrown off. The mahout and I fell clear, but my wife when hurt her spine and even now, years later, feels the effect of that fall. She lay very close to the elephant, which was struggling to rise, and had I not pulled her away in time, she would have been crushed for, just as she got clear the elephant fell again, this time on its right side. A narrow escape indeed. Such accidents are fortunately rare for the sagacious beasts well know the danger of a fall. It was only after several attempts that our elephant was able to gain its footing on firm ground.

Being certain that one of the tigers in this beat would be the man-eater the mahouts asked that there should be two or three howdah elephants with the beating line; so I and the two M's said we would go across the stream. I made my way over with much difficulty, but M. Junior's elephant got firmly bogged. When M. Senior saw this he called out in his humorous way, 'I have seen what your elephant had to do, to get across, and what I am seeing', pointing to his brother's elephant, 'persuades me not to attempt it, for one elephant', pointing to himself, 'on top of another elephant would certainly become permanently bogged; so good luck to you!' and off he went to join the line of howdah elephants which were being led to a crossing further down.

Following in single file along the bank of the stream, to a point beyond where the slain cow had been taken across into the long grass, the beating line turned left with myself on the left. It was very soon apparent that a tiger was before the line for several elephants were giving the usual signs. The tiger was not worried and carried on, as could be seen by the 'hullee', but after a while he began to move back and across and to grunt and growl to show his displeasure at being forced to move. The sounds he made did not indicate any intention to attack, but were merely warnings to the elephants not to tread on his tail!. Whenever the tiger came near me the mahout urged me to shoot, and even the head shikari, Phata, said I must kill the tiger or he would presently charge and get away after doing some damage. Such was the fear put into all these experienced men through the knowledge that a man-eater tiger was before them. As a matter of fact there was no more danger than from any other tiger with less evil reputation. The mahouts were very nervous and their fears were being communicated to their mounts, so it was apparent that I ought to take an opportunity, if one presented, and not adhere to the rather strict convention that no tiger may be shot from the beating line.

The elephants were closing on me in quarter moon formation, and after a time there was no movement to be seen as we were now in taller and more dense grass. Suddenly the tiger rushed from almost beneath my elephant but a little to the right. I could not see him but the mahout from his position on the elephant's neck was able to do so. Reaching back he placed his hand on mine clasping the howdah rail and directed attention to a place where the huge back of the royal beast was visible through the grass stems. The target was one I could not miss, and firing with the .280 the great beast pitched forward without a sound and rolled over on his right side. A number of mahouts called out to shoot again, and again, but I knew there was no need as when a tiger falls in his tracks without an answer to the shot it is certain he is dead. However, I fired two shots to satisfy them. The line continued to advance but there were no more tigers, though two in an adjacent cover had not been too much disturbed and were later driven out and shot. One of them charged the Raj Kumar, who was favoured on this shoot with all the charges! He charged repeatedly and fought to the end, being at last killed by one of the other guns as he was pursuing the Raj Kumar's retreating elephant. Had he caught up with it he would possibly have mounted behind and tried to get at the occupants of the howdah.

The Maharajah of M. had returned to the shoot and I was disappointed at having had to kill the tiger which should properly have been driven to him. The Rajah of G. ruled that I had been quite right, and congratulated me on getting this fine beast which measured ten feet over the curves in spite of having a very short tail. He was a very heavy, powerful beast and in his prime, having no apparent excuse for his evil taste for human flesh. That he was the man-eater is certain, for when we visited the place the following year it was found that all killings had ceased from the day he was shot. When the howdah and other elephants assembled round the dead tiger both sportsmen and beater mahouts cheered me, the demonstration being started by the Rajah, which was nice of him. The spontaneous and genuine gratification at my success was so sincere that I shall ever remember it. After ten days we left the camp; fourteen tigers had been shot. Twice in previous years the total killed amounted to no less than thirty-two. The total for this year was 18 tigers, three bears, two buffaloes.

Mention has been made of six tigers killed in one hour. That is not very remarkable in heavy grass jungle when a number of elephants are used; but a well-known official named D., a very fine rifle shot, on one occasion killed five tigers in less than one hour all by himself off a single pad elephant, and she untrained! This was not far from the town of Goalpara, and when he met us at Dhubri and told us about it, he said that there were perhaps another ten tigers collected there and he had desisted from attempting to kill more of the animals as the elephant was showing signs of fright, and no wonder! It is probable that this unusual assemblage was on account of a love-making affair and D was

fortunate not to have been attacked as in such circumstances male tigers are most aggressive.

I have seen the wild Mithun in Assam, also the semi-tame mithun. The latter are met with in the Lushai Hills. There is a difference between the semi-tame and the wild Mithun in Assam. Neither of them are *wild* cattle like the Banting, or Tsine, of Burma. They are large, heavy animals. One day in the rainy season two of these beasts arrived at Dhubri and one was shot by Indians with 12 bore spherical bullets: the other got away. The mithun that was shot had two horns growing from one side of its head and one on the other side. None of the three horns were rudimentary ones, but well developed horns as is clearly seen in a photograph that was taken. I bought this head and gave it to the Rajah of G who had it set up, and no doubt it is on a wall in his palace to this day.

Other strange animals used to come into Dhubri. Perhaps they were carried down by the floods of the Brahmapootra and unable to land before getting to Dhubri, from which the jungles are far away. A clouded leopard was killed one year by Mr. K. the Pilot Superintendent of the river, with a shot gun. It was inside a drain, and much pleased was K when he found he had bagged such a rare and beautiful creature.

#### Bears.

I have been told by sportsmen, and have read the statement in many books, that a bear stands up to attack a man. I am talking about the sloth bear of India. One has to keep in mind that the same species may behave differently in various parts. What they do in Assam may be quite different to what they do in the Central Provinces and other parts of India.

In the Hill Districts of Assam, Naga Hills, Lushai Hills, Garo Hills, Mishmi Hills, Sadya Frontier Tracts, etc., I have spoken to many men who have been attacked by the sloth bear, and without exception all say that the bear does not stand up to attack, but rushes in, and after knocking the person down may attack the head and damage the scalp, but is just as likely to damage the thighs or whatever he can get hold of.

I have met about twenty cases, and they all told the same story of which the following is a typical example. An old Lushai man with some others shot at and wounded a bear with spherical bullets from a shot gun. Next morning they followed up, and the gun missing fire, the bear rushed into Luma and knocked him down. Then, as Luma attempted to get up, the bear bit him in the back, as well as the buttocks and also got hold of his right hand and bit off the thumb. Other Lushais then killed the beast with a spear.

I had once to give medical aid to a Survey Officer mauled by a sloth bear. He had been carried for about three days in an improvised bamboo litter by coolies and arrived about ten in the morning. He was in a dreadful state and the smell was so great that one could scarcely remain near the stretcher. We were at the Damra Inspection Bungalow so my wife at once prepared a bed;



and as I had practically nothing with me to treat such a case all I could do was to put permanganate poultices on the wounds to clean them up. After washing his person and dressing the wounds he was more comfortable and slept till the evening.

It was learnt from him that he had a black cocker spaniel, and when he saw a black object coming towards him in the grass was not prepared to meet the rush of a bear which took place before he could do anything with his gun. He was knocked over and the bear proceeded to bite his right thigh above the knee joint. He lost consciousness and on coming round shouted for the coolies who had all run away. The shouts brought the bear back and he was again attacked and put up his right arm to save his face. His arm was then badly mauled, also the left arm was bitten. He must have then again fainted, and on coming to his senses decided to make for a tree. As he got to the tree the bear again attacked, but passed along down the path and left him. He ran in the opposite direction and collapsed, the next recollection being that he was in the stretcher: and so he journeyed for three days, being kept alive on milk obtained from the villages. He remembered that while on the ground another bear stood by without attacking: this of course was a cub.

The wounds were neglected and serious. An injection of streptococcic serum was indicated but I had none with me. I drove the injured man 70 miles to Gauhati and from there sent him without delay to the Mission Hospital in Shillong. Later on I heard from him that his leg and right arm, which had received the most serious wounds, were healed and as well as ever; but the left arm, which was slightly mauled, was paralyzed.

Undoubtedly sloth bears are very dangerous animals and frequently attack without provocation, most of such cases being females with cubs at foot. They are particularly tough brutes, and soft nose bullet from a powerful rifle should be used against them.

#### *Miscellaneous :*

In regard to wild animals in Assam almost anything is possible, so when I met a young Mahomedan Assistant Surgeon at Fulbari, with a tale of a rogue elephant and a man-eating tiger, I quite believed his story, though I afterwards verified it through a report to the Deputy Commissioner. He had been ordered to make a Kala-azar survey of the villages within reach of the road between Tura and Fulbari. On reaching the first Inspection Bungalow of the two which are on that length of road, he was told by the chowkidar that a rogue elephant had on the previous night demolished the Subordinate's hut, so he decided to push on to the next Inspection Bungalow. Arriving there at about three in the afternoon he was informed by the chowkidar's wife that her husband had been caught the previous night near his hut by a tiger which had killed and eaten him! Some Garos of the neighbouring village had found the remains that very morning, so she was ready packed up to go to her home. The young Sub-Assistant Surgeon therefore went on to Fulbari, where I met him. He returned to

Tura, arriving there before I did, developed blackwater fever and died before my arrival. The treatment of blackwater with the leaves of *Vitex penduncularis* was not then known. It was originally discovered by Santhals. At first a liquid extract was issued by Government but proved useless. Then the method which proved successful, and may be deemed to be a specific, was adopted. This was to make from the dried leaves a strong 'tea', which may be taken with milk and sugar, of which a total of about a quart a day—usually three times a day—is given, but the total of the quart not exceeded. (*Vitex penduncularis* is a tree of the Botanical Order *Verbenaceae* and of the genus *vitex*; about fourteen species of which occur in India. In Assam the vernacular name is *Osai*, and in Santhal it is *Mara kata*, also *Bhadut*.)

The Kala-azar Survey was eventually completed and a hospital built near Tura. A village at a time was attended to, and in this way a large number of cures were effected with Dr. Brahmachari's treatment, which is certainly a cure. It was at one time thought that the common bug was the carrier of the disease, but it could not be proved that it was so. It has now been definitely proved that the true carrier of the disease is the sand fly *Phlebotomus argentipes*.

#### *Doings at Dhubri:*

Here is a true tale of a tiger and the Police at Dhubri. A tiger mauled a Police constable and was next day found in the compound of the Forest Officer, who was out of the Station. Mr. A. the Police Superintendent, ordered buckshot ammunition to be issued to the men. The tiger was seen in some bushes which ran along one side of the house and the Police opened fire. Meantime Mr. C. of my Service got on the roof of the bungalow and from the top verandah killed the tiger with one shot in the head. When the tiger was examined it was found that not one single buckshot had struck the animal! The only wound was Mr. C.'s bullet in the head. Mr. C. let the Police have the skin and it is perhaps still to be seen at the Dhubri Police Station. Mr. D., the Inspector-General of Police, was often ragged about this affair and asked how he was going to account for some seventy rounds of buckshot!

Here is another story concerning the Police. It also is a Dhubri tale—the tale of a Missionary's claim for a tiger skin. All officials were out of the Station on tour when some men reported to old A.M., Local Superintendent of Police, that a tiger was lying in the doorway of a cow-shed so that the cattle could not get out nor could the herdsmen approach. The old Officer took no interest in shooting but possessed a .405 Winchester rifle and a shot gun; and as there was no one else to destroy the tiger he considered it his duty to do so. Taking with him his weapons and a Police orderly he started off, passing the house of a Missionary on his way. The Missionary, learning what was afoot, also took a rifle and they went together to the village. Men pointed out the shed some seventy yards away and Padre B. said he could see the tiger so got on the roof of a hut. Old

Mahomed said it was too far and he would go closer to investigate, as all good Police officers do, and got within nine feet of the tiger which he could see the other side of a grass and mud wall of a broken down hut. He returned to the Padre and told him to come closer to the place where the animal was plainly visible. 'No' said the reluctant Parson, 'this is a better place'. So the old man returned to the nine foot! stance to find his orderly with the shot gun had disappeared. Just as Mahomed was considering how best to poke his rifle barrel through the flimsy wall the Padre fired a shot which whizzed over his head! The tiger now began to take notice so, as the old man afterwards related, he thought it time to act. Pushing his rifle barrel through he got a sight on the tiger's back and pulled the trigger. 'Then', said Mahomed, 'there was an earthquake, and the wounded brute flew round and round scattering bits of wall and shed in all directions. I found the tiger looking daggers at me so pointed the rifle at his head and this time he fell dead.' •A bullock cart was procured and the tiger was being taken to Dhubri when the valiant Padre claimed the tiger as his property! Just then the Deputy Commissioner returned from tour, and after hearing all the story and examining the tiger asked M. why he was giving up claim to the skin as, though the Padre said he could not have missed at seventy yards, it was impossible for the bullet fired from the top of the shed to have entered near the tail and traversed to the chest, and no other bullet hit the animal except those fired by M, 'Tell him the skin is yours.' The Padre was very angry and insisted he had hit the tiger and the skin should be his. At a tea party a few days later the Padre challenged old M to a shooting match saying that whichever of them made the best score should have it. 'Yes', said the brave old officer, 'we will shoot for it, and the range shall be nine feet and not seventy yards'! No doubt this answer had been suggested to him. Every one was very indignant that the Padre fired a shot from so far when M. was so close to the tiger, as it was a dreadful thing to have done and might have cost old M his life.

S., who was with me when we shot a big buffalo, met with a sad end. He was then Forest Officer of the Goalpara District and in camp at Kochugaon. We knew him very well, and he had toured with us in the Garo Hills on many occasions. The telegram asked for urgent help so de C. and I set out in the Tin Lizzie to drive the fifty miles over bad roads and through forest. When I reached S. I was shocked to find he could not move, and after hearing what had happened soon discovered he had no sensation from the feet upwards to a point  $1\frac{1}{2}$  inches above the nipple line. This meant a high-up fracture, or dislocation, or both, of the spine, and also meant death. He was taken to the General Hospital, Calcutta, accompanied by his wife who left behind her Ayah and two babies. The younger of the children, then about six months old, is now an Officer in the Royal Navy.

S. had built several narrow gauge timber extraction line bridges over ravines, and returning over one of these the trolley wheels struck the obstruction caused by one rail overlapping another by a quarter of an inch, the result being that the trolley overturned

into the ravine. Mr. J., also on the trolley, fell first and S. on top of him and the trolley on S. So it would seem that the spine was fractured by the trolley as it descended. This would account for the double injury—the fracture and the dislocation.

### *A Panther Story :*

On the Tura-Fulbari road there was an Inspection Bungalow, I have forgotten the name of it, the chokidar of which was killed and taken away by a tiger. For long after this occurrence it was said by the Garos living in those parts that a black tiger was killing people within a radius of twenty miles. It was probably a black panther. I have read in several books that black tigers exist in India, but never has the authentic death of one been recorded; so the question remains, 'Is there any such thing as a *black* tiger?' Whatever the correct answer, the Garo Hills 'Black tiger' was never bagged. I have not come across any explanation as to why there should not be black tigers as well as black panthers which are quite common where there are dense and damp jungles inhabited also by tigers.

Well, I went to this bungalow in connexion with Kala-azar. We arrived about tea time, and after tea I was talking to the Inspector of Vaccination outside the bungalow near some fairly heavy jungle, for the place is in the midst of forests. Suddenly a squirrel started to make a noise. We looked at one another for there is always a cause for bird and animal noises in the forest, and both of us knew that this meant the vicinity of either a tiger or a panther. I had just said we had better be getting inside when there was a rush towards us, and the animal came right to the edge of the cover. I caught hold of the Inspector to prevent his running, and we backed until we reached the bungalow steps—then we ran! I seized my .475 rifle and fired a shot in direction of the rush. As there was a large hole in the wall near to head of my bed it would have been foolish to sleep there, so I explored the Subordinates' Quarters and found a safe room to contain myself and all my staff and servants. It was rather a crush but had to be endured. Next morning it was found by the tracks that a panther had jumped a small stream and then made his rush. It was before he jumped the stream the squirrel had chattered at him.

When I related all this, later on to G. he ruled that it was only to get us out of the way that the panther had made his demonstration, his real objective being my pony tethered to a stake in the clearing to right of the bungalow. However that may be I still claim that it was a man-eating panther which contemplated making a meal of me!

*(To be continued)*

# FIELD NOTES ON THE BIRDS OF THE ANAMALAI HILLS (COCHIN).

BY

C. R. STONOR.

The observations upon which this paper is based were made in the evergreen and deciduous forests of the north area of the Anamalai Hills, where these hills merge into the Nelliampathy Range, at an altitude of 1,500 to 2,000 ft., and between February 12th and March 11th, 1944.

That these notes are but fragmentary I am only too well aware; however, the very fact that it was possible within the space of a month to make observations hitherto unrecorded or at least unemphasised on the distribution, ecology, and natural history in general of a number of the wonderful jungle birds of South India, is in itself evidence of the vast and almost untouched field still lying fallow for the naturalist in this country. Certain features struck me as particularly noteworthy, and as crying out for scientific investigation; of these I give a few concrete examples:—

I was especially struck during my tour by the extraordinary social habits of so many of the *Timalidae*—the Babblers and Laughing Thrushes—birds which seem to have abandoned all individuality, and to have evolved a 'social system' wherein each and every member of a flock exists only as a minor unit within the group, to an extent far surpassing any other family of the Passerine birds.

Again, the discontinuous and 'patchy' distribution within a small area of forest shown by so many bulbuls is an ecological problem which would richly repay study, but which remains up to date quite unexplained.

To come down to a particular species; to know however slightly the Great Hornbill (*Dichoceros*) is to give it a unique niche in the community of jungle birds—yet we can pretend to no more than the most sketchy knowledge of any part of its ordinary everyday life.

Turning lastly to Courtship, Display, and the whole cycle of breeding activities, the strange trios which are such a feature of the Drongos are unexplained, the courtships of the Hoopoe, the Grey Hornbill, the Fairy Blue Bird, the Stork-billed Kingfisher, the whole family of the Pittas, the Barbets, and the Bee-eaters, remain totally unknown.

We know today the main details of the geographical distribution of the majority of Indian birds; we know the colour and number of their eggs, and the structure of their nest; but as for their Ecology, Breeding Biology, and Field Natural History in general, not only does plenty remain to be done, but not even the cream has been skimmed off.

All references to Sálím Ali refer to the 'Ornithology of Travancore and Cochin' by that author, published in the *Journal of the Bombay Natural History Society*, Vols. vii-ix (1935-7).

I am also indebted to Mr. Sálím Ali who has found time in the course of his tireless and relentless wresting of ecological information from Indian birds to edit these notes.

Finally, I am glad to record that the havoc said to be wrought by the aboriginal Kadar tribe on the avifauna of the hills, is certainly not true of the northern area, where their supine indolence is such that not even substantial remuneration could persuade them to help me look for nests.

## LIST OF BIRDS

(NOMENCLATURE ACCORDING TO 'THE ORNITHOLOGY OF TRAVANCORE AND COCHIN').

### PASSERES

***Corvus macrorhynchos culminatus*.** The Southern Jungle Crow.

One at Parambikolam; the local forester was surprised when I pointed it out to him, and informed me that Crows are particularly unknown in this area.

***Dendrocitta leucogastra*.** Southern Tree-Pie.

Very common in evergreen forest; but I never saw it in deciduous. The birds were always in pairs and rather tame—presumably breeding had not begun. They were extremely silent and although I watched many pairs, I never heard the call-note. They habitually came down to feed on *Lantana* berries. This pestilential plant is definitely become an important factor in the distribution of all fruit-eating birds.

***Garrulax delesserti*.** The Wynaad Laughing Thrush.

I saw several parties, of from ten to thirty birds sneaking through the undergrowth in typical Babbler style. One party was in purely deciduous forest. They kept up a continuous low muttering, but even when I purposely alarmed them, did not break into the squeaks and gabbling customary in this family. I heard one call-note similar to the throaty 'chirp' of a fledgling of the true Thrushes.

***Turdoides somervillei malabaricus*.** Malabar Jungle Babbler.

Very common in deciduous and mixed jungle only. I was watching a flock feeding one morning, when for no apparent reason one member fluffed out its plumage and shrieked and jabbered at the top of its raucous voice. In an instant every other member of the flock had stopped feeding and dashed to the spot, muttering and squawking. The originator of the disturbance quieted down, and the whole party moved off in another direction as if nothing had happened.

***Pomatorhinus horsfieldi travancor iensis*.** Southern Scimitar Babbler.

Only once seen; a single bird in evergreen forest: apparently not very common in the area.

***Ægithina tiphia multicolor*.** Ceylon Iora.

On March 7th, I saw the beautiful aerial display so well described by Hugh Whistler (Popular Handbook of Indian Birds, 3rd edition, p. 61); during the spiral descent with fluffed-out plumage, only the black and white colours seem to be used, and the yellow underparts are not at all obvious. It does not seem quite definite as to whether the display is aggressive or designed for the female. At the time when I saw it, there was a female nearby, but there was also another male in the same tree.

• ***Chloropsis aurifrons insularis*.** Golden-fronted Chloropsis.

Fairly common, especially in mixed forest, and usually in pairs.

**Molpastes cafer cafer.** Red-vented Bulbul.

I found it only in one very restricted area at Parambikolam where I located a nest with three eggs on March 5th. Sálím Ali also recorded it as curiously uncommon in the hills. It was entirely absent at Kuriakutty in identical country only eight miles away.

I found bulbuls in general to be extremely patchy in their distribution; a species would be very plentiful in one area and apparently absent a few miles away; the ecology of this would be a very interesting study.

**Otocompsa jocosca fuscicaudata.** Southern Red-whiskered Bulbul.

Very common throughout the area—the only bulbul with continuous distribution.

**Iole icterica.** Yellow-browed Bulbul.

Common to abundance in a strictly limited area of evergreen and mixed forest at Kuriakutty. Mainly in pairs (up to Feb. 29th.) and breeding had apparently not begun.

**Pycnonotus gularis.** Ruby-throated Bulbul.

This very beautiful bulbul was abundant at Kuvallé, especially in the *Lantana* bushes, but was scarce elsewhere; it seemed rather to replace *Iole* and *vice-versa*. The white eye stands out very clearly in the field.

**Copsychus saularis ceylonensis.** Magpie-Robin.

The Magpie-Robin was fairly common in most places. I found it one of the shyest of birds, diving into undergrowth on the slightest alarm—a complete contrast to its behaviour in populated areas on the plains.

**Geokichla citrina cyanotus.** White-throated Ground Thrush.

Sparsely distributed throughout the area. Always solitary, and with a fondness for the recesses of the bamboo clumps.

**Myophonus horsfieldi.** Malabar Whistling Thrush.

Its school-boy whistle was all-pervading. Not only was it first up in the morning, but I often saw it feeding on the edge of clearings when almost dark in the evening. Always solitary.

**Ochromela nigrorufa.** Black-and-Orange Flycatcher.

Like Sálím Ali I failed to find it, although I looked for it particularly.

**Tchitrea paradisea paradisi.** Paradise Flycatcher.

Common everywhere, and nearly always alone. Even allowing for the greater conspicuousness of white-plumaged birds, I found adult males very much commoner than brown-plumaged birds. One of the few brown birds I saw was in a curious phase of plumage; entirely brown with the tail streamers fully developed and pure white. I saw one adult male taking insects off the surface of a pool-dancing over the water, and splashing his tail-streamers every time he swooped to take his prey.

**Pericrocotus flammeus.** Orange Minivet.

Common everywhere; and mainly in pairs or small parties up to March 10th.

**Lalage sykesi.** Black-headed Cuckoo-Shrike.

Only met with at Parambikolam, in deciduous forest, where it was in small, silent parties. I did not meet with *Graucalus* (a bird I know well in Assam).



**Dicrurus longicaudatus longicaudatus.** Grey Drongo.

I have only one or two doubtful identifications. I mention this since Sálím Ali describes it as 'replacing' the Black Drongo in hills and wooded areas.

**Chaptalia aenea malayensis.** Southern Bronzed Drongo.

Very abundant everywhere and in all types of forest. I saw a bird on a nest on February 29th, and another chasing its much larger Racket-tailed relative.

**Dissemurus paradiseus malabaricus.** Malabar Large Racket-tailed Drongo.

This bird, always a joy to see, was abundant throughout evergreen forest and not unknown in deciduous. They were largely in small parties up to about the end of February, but by March 10th were mainly broken up into pairs. The curious trios which one so often sees among drongos of all species were a feature of the Racket-tail; it would be interesting to know something of their significance.

One evening I watched a mixed party of this and the Bronzed Drongo hawking winged termites. The Bronzed species circled round in horizontal flights while the Racket-tailed preferred a more vertical swooping and diving. I was quite unsuccessful in efforts to see how the tail rackets are used in display; but since the species is easy to observe, it is to be hoped that someone will take up the subject.

**Irena puella puella.** Fairy Blue-bird.

Among the commonest birds; they came down every afternoon from the high trees in noisy twittering parties, swarming through the *Lantana* bushes, the berries of which they have a great fondness for. During February they were in flocks, but by March were breaking up into pairs. While they were in parties, the males were much more in evidence than the females—not only from their brighter colouring—so that it is possible the two sexes may have slightly different habitats outside the breeding season. Also not uncommon in mixed forest and just extending into the edges of the deciduous zone.

A male Fairy Blue-bird feeding among the brilliant scarlet blossoms of an *Erythrina* tree is of all bird scenes in the jungle 'the loveliest and the best.'

**Oriolus oriolus kundoo.** Indian Oriole.

Abundant throughout the area and in all types of forest; always single or in pairs.

**Gracula religiosa indica.** Southern Grackle.

Perhaps the commonest bird in the area; they were in flocks up to the early days of March, when they were definitely breaking up into pairs.

**Motacilla maderaspatensis.** Large Pied Wagtail.

Only at Parambikolam and Kuriakutty. A bird carrying nesting material on March 7th.

**Pitta brachyura.** Indian Pitta.

Very scarce; I found the long dead remains of one bird at Kuvallé, and saw one at Parambikolam, thirty miles away on March 1st.

**CORACIIFORMES****Macropicus javensis hodgsonii.** Malabar Great Black Woodpecker.

Sálím Ali describes this species as confined to evergreen forest; but I also saw it in deciduous at Parambikolam. The call was a loud musical 'Clawk'—a call not typical of the woodpeckers.

***Xantholaema rubricapilla malabarica*.** Crimson-throated Barbet.

A barbet of this genus was very common in evergreen forest; I was only able to get near one or two, and identified them as this species. I had been studying the Coppersmith (*X. haemiocephala*) only a few days before coming up to the hills, and the call of the forest birds at once struck me as quite distinct in that it was more hurried, as if the producer was anxious to get it finished, and also had less of the metallic 'clang' of the Coppersmith. I am strongly of the opinion that most if not all the *Xantholaema* barbets of the area belong to the Crimson-throated species.

***Hierococcyx varius*.** Common Hawk-Cuckoo.

Sálim Ali considers it as rather uncommon above 1,000 ft., and I fully endorse his opinion; I did not meet it at all in evergreen forest, and heard it occasionally by night in rather open areas near Parambikolam.

***Centropus sinensis parroti*.** Southern Crow-Pheasant.

This peculiar furtive bird was common everywhere. To see it on a 'prolonged' flight-crossing a short stretch of open water with its big tail spread, and the little wings only just buoying it up, has a touch of the prehistoric about it, and gives a very fair idea of the flight of the fossil *Archaeopteryx*. It would be interesting to know if it is a weak flyer for anatomical reasons, or if a case of 'letting I dare not wait upon I would'.

***Psittacula columboides*.** Blue-winged Parrot.

Common to abundance, especially in evergreen forest, but also in mixed and deciduous biotope. I think they were breeding in deciduous forest at Parambikolam. They habitually came down to feed on the *Lantana* bushes in close proximity to the Blossom-head (*P. cyanocephala*) but the two species never mixed, either in the bushes or when put to flight.

***Psittacula cyanocephala*.** Blossom-headed Parrot.

Common in mixed and deciduous forest, especially at Kuriakutty, where Sálim Ali does not seem to have met with it.

***Coracias benghalensis indica*.** South Indian Roller.

I often saw solitary birds, keeping well to the tree-tops in deciduous forest. They were quite silent, and never displayed. In most parts of South India breeding is in full swing by this time; and I am of the opinion that these were either non-breeding birds, or winter visitors from another part of the country.

***Eurystomus orientalis*.** Broad-billed Roller.

This interesting Roller was common throughout the area, in all types of forest with an apparent preference for the mixed zone; and invariably in pairs. They kept to the edges of clearings, or along the river bed, in high, open trees, and in my experience never came near the ground.

One evening I watched a pair hawking a swarm of winged ants in company with a party of Grackles, the Rollers flying round and round in a large circle, twisting and turning in a Nightjar-like flight, and never moving out of the same small clearing.

Sálim Ali refers to its making sallies after winged insects, and I never saw it feeding on the ground like *Coracias*; so that it seems probable it takes all its food on the wing—for which its broad mouth, apparent even in flight, is well adapted.

It is interesting, especially in view of its very different appearance from the Blue Roller, that it has precisely the same series of calls as that species; the same harsh scream on the wing, and the same 'chark-chark' greeting call. All its calls are, however, on a higher and sharper note. I saw no display of any kind, although they were so closely paired off. When seen from below, the Broad-billed Roller has a very characteristic silhouette; its broad head, and relatively long neck jut out rather sharply in front of the wings; the light wing patch, and the orange bill also stand out clearly in the field.

***Merops leschenaulti leschenaulti*. Chestnut-headed Bee-Eater.**

The fine Chestnut-headed Bee-Eater was quite common along open tracts throughout the area; always near water. They were solitary, in pairs, or small parties, and very silent. I saw no display or evidence of breeding. The chestnut head is not always obvious, but the creamy buff gorget, and sea-green of the lower back are good recognition characters.

I saw a bird of this species on March 21st in the centre of the town of Ernakulam—a strange locality for a forest bird. Perhaps on migration?

***Alcedo atthis taprobana*. Ceylon Common Kingfisher.**

Sálim Ali and others describe the Common Kingfisher as uncommon in the hills. It was however quite plentiful on the streams and riverbed. I did not meet with the Pied Kingfisher (*Ceryle*).

***Ramphalcyon capensis*. Stork-billed Kingfisher.**

The massive Stork-bill was present in pleasing abundance along the riverbeds. It has a penchant for flying straight through the fringing bamboos and small trees by the rivers—which it does with uncommon skill. Solitary or in widely separated pairs. In addition to its far carrying, and raucous laughter, I heard a completely different call—a loud, musical and rather mournful double note. Perhaps a breeding call?

***Dichoceros bicornis*. Great Indian Hornbill.**

I put its density at roughly 1.5 pairs per square mile. The breeding season seemed to be just beginning, as I saw about equal numbers of pairs and solitary birds. I do not agree with Sálim Ali's suggestion that they suffer from the depredations of the Kadar tribe who relish the 'squabs'—I was unable to persuade them to help me look for a nest in spite of an offer of Rs. 10 for each nest located.

A very large male which was unfortunately shot for my benefit, was extremely fat and had the stomach crammed with small yellow figs. A solitary bird came three nights running to roost in deciduous forest at Kuriakutty, and seemed to be unmated.

It is hoped to publish a separate account of the natural history of this magnificent bird.

***Hydrocissa coronata*. Malabar Pied Hornbill.**

Not very common. I watched a pair on the bare branches of a giant *Bombax* tree shortly after dawn on February 17th. The male was caressing the female, preening her neck, and every now and again hopping over her back to repeat the operation from the other side. She was passively submissive, and after a few minutes it culminated in pairing, following which the two flew off. They were both silent.

It is interesting to note that when a pair of the nearly allied African genus *Bycanistes* attempted to breed at the London Zoo in 1936, the same caressing of the female and jumping over her on the part of the male was the only courtship I saw.

***Tockus griseus*. Malabar Grey Hornbill.**

Very common in all types of forest; sometimes feeding on *Lantana* berries. Almost always in pairs up to March 10th.

***Upupa epops ceylonensis*. Ceylon Hoopoe.**

In deciduous forest only, where they were common; always solitary. From the general demeanour and since I never saw one carrying food, I do not think they were breeding, although this is the normal breeding season on the plains in South India. So possibly these birds were winter visitors. I had been watching the northern race in the Central Provinces some weeks previously, and found the richer colouring of *ceylonensis* very marked. The sight of a Hoopoe with its crest elevated and glowing orange from the evening sun shining though it makes its place in solar mythology abundantly clear.

**Harpactes fasciatus malabaricus.** Malabar Trogon.

Not uncommon in deciduous forest. Fairly tame, and at once recognisable, when the colours cannot be seen by its short 'flits' from tree to tree. Most were in female plumage.

**Chaetura giganteus indicus.** Brown-throated Spinetail.

A small flock of this splendid Swift was always to be seen at Kuriakutty. The speed and dash of a party 'balling' in the late afternoon when they regularly hurtled down almost to ground level, was literally frightening.

**Hemiprocne coronata.** Indian Crested Swift.

Only once seen; a small, noisy party in deciduous forest. In spite of its much emphasised resemblance to a Swallow, the long sickle curve of the wings at once proclaims its affinities in flight.

**Lyncornis macrotis bourdilloni.** Bourdillon's Great Eared Nightjar.

A very large Nightjar, both actually, and relative to others on the wing at the same time, regularly hawked over open ground at Kuriakutty. Its flight was the same as of the small species.

## ACCIPITRES

**Ictinaetus malayensis perniger.** Indian Black Eagle.

Common, and often flying through the lower branches of the trees in pairs; possibly a courtship flight.

**Ichthyophaga ichthyaetus.** Grey-headed Fishing Eagle

A single bird soaring over the forest on February 26th.

## STEGANAPODES.

**Anhinga melanogaster.** Indian Darter.

Fairly common on the river in all areas.

## HERIDIONES

**Leptoptilos javanicus.** Lesser Adjutant.

A single bird on February 13th in a statuesque attitude on top of a very high dead tree in the foothills immediately East of Chalakudy.

**Dupetor flavicollis.** Black Bittern.

On March 3rd I came across a Black Bittern crouched by the side of a small open stream at Parambikolam. It remained flat on the ground until I was almost on top of it, when it darted away to cover.

**Dutorides striatus javanicus.** Indian Little Green Bittern.

A small heron, almost certainly this species was uncommon on the larger streams. They were always solitary, and usually flew up into a tree when disturbed.

# THE FRESH WATER FISH AND FISHERIES OF AHMEDABAD.

BY

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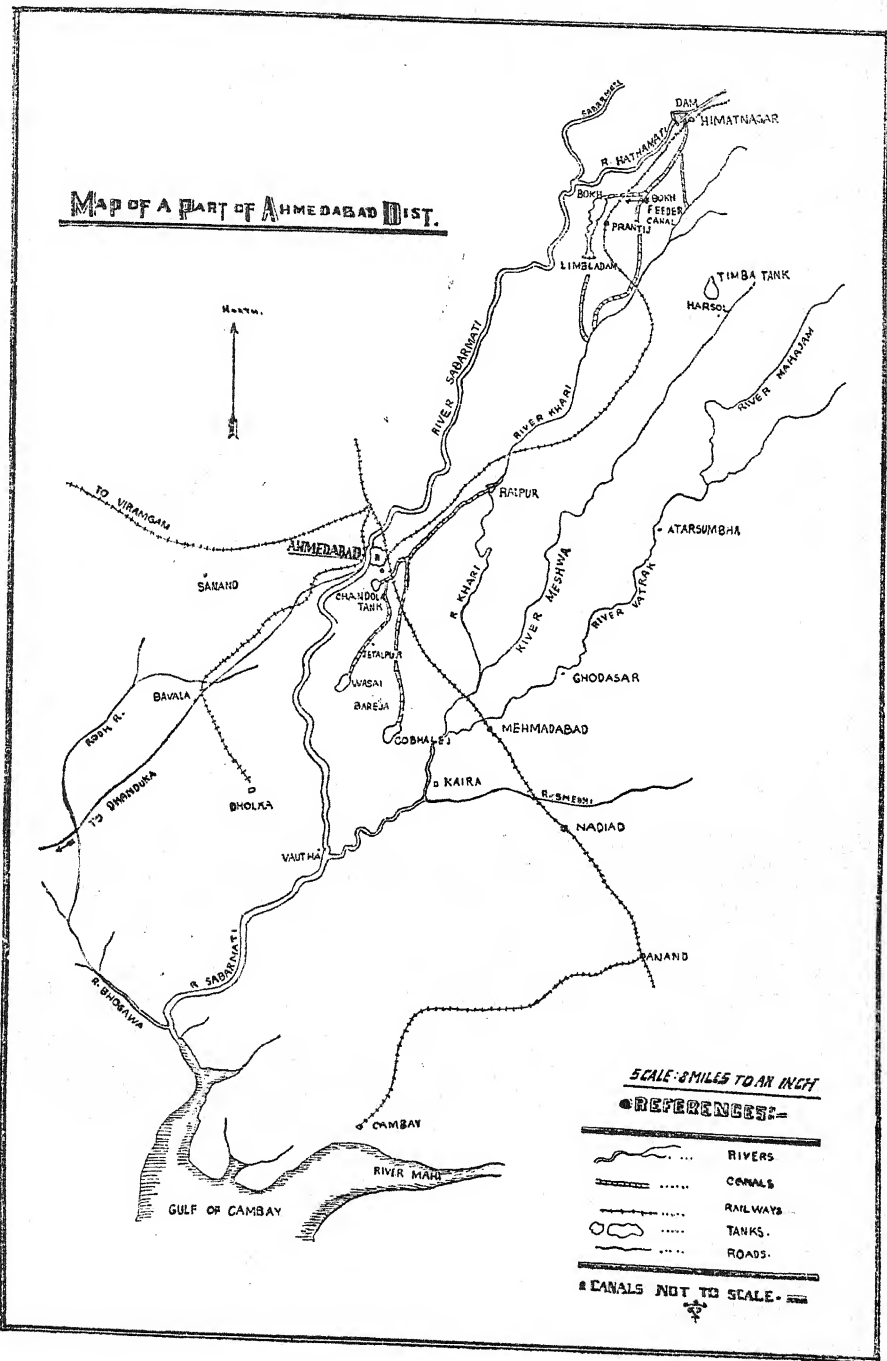
*(With a map)*

The richness of the fresh water fisheries of Ahmedabad district is not generally known, and was brought to light only recently after a survey of some of the sheets of fresh water there. Of all the districts in the Province of Bombay, Ahmedabad seems to be singularly fortunate in the availability of fresh water fish practically throughout the year. Its ponds and reservoirs are said to cover an area of more than 13,946 acres. The rivers and tanks in this area do not dry up to the same extent as in other parts of the province owing to the dams and canals in the upper reaches which regulate the supply of water. This probably accounts for the fairly even distribution of fish.

One reason that may explain the conservation of fresh water fish in the Ahmedabad district is the existence of restrictions prohibiting the catching of fish in several tanks. These restrictions are due in no small measure to the religious tenets of the Jains, which prohibit them from taking life. Their influence is also responsible for restriction on fishing even in such sheets of water as are not controlled by them. Besides the existence of tanks and ponds, another source of fish is the river Sabarmati on which is situated the city of Ahmedabad. The Sabarmati flows almost throughout the year, though in the hot weather it is little more than a stream.

## *Sources of Supply.—*

Besides the Sabarmati, other sources for the supply of fish are the Rodh river across the Ahmedabad—Dhanduka road, and the Khari, Vatrak and Meshwa rivers on the eastern side. The catches in the rivers are, however, not large, and even if to these were to be added the catches in the Sabarmati, the total quantity would hardly be sufficient to meet the entire demand in Ahmedabad. Measures to increase the existing supplies will gradually become more imperative in view of the steadily growing population of the city, consequent on its industrial expansion, specially the increase







in the number of textile mills. The present difficulties in regard to supplies are at present no doubt eased to some extent by imports from Prantij, Mehmedabad, Dholka, Sanand and Varaval, at all of which places fairly satisfactory catches are made. Prantij, 41 miles from Ahmedabad, is the site of the well known Bokh reservoir, which is considered to be a rich area for fishing, the catches being usually despatched by rail. Mehmedabad is situated along the river Vatrak, a tributary of the Sabarmati which it joins below Ahmedabad. Good fish is also available in pools in the Vatrak formed near the villages of Barapada, Atarumbha, Ghodasar etc.

Veraval has long been noted for the richness of its marine fishes. The fishing season here is briskest in October and November, and small quantities are usually despatched to Ahmedabad, where there is always a ready market for fish. Import of fish from Veraval has considerably declined, however, of late owing to the curtailment of train services. Marine fish from Bombay and Bassein, therefore, find their way to this market only during the season. Ahmedabad is also occasionally served by supplies from Cambay which is situated on the sea.

#### *Quantity and Variety of Fish.—*

No regular statistics are available of the quantity of fish sold in Ahmedabad. This defect could easily be overcome as Ahmedabad has only one market for the sale of fish and the entire quantity obtained from various sources is sold there, apart from insignificant amounts peddled by hawkers. Inquiries in the market show that the present sales of fish average only about 10 and 50 maunds (daily during the slack and brisk seasons respectively). The sales might have been larger but for the comparatively high price at which fish is sold in Ahmedabad.

The variety of fish found in the Ahmedabad district is large, specially when one bears in mind that the rivers are not deep or long. Observations show that the medium sized fresh water fishes *Cirrhina mrigala* (Nagari) and *Barbus* (Tor) *Mussullah* (Bhasera) appeared to be most common. Next in order of abundance was *Labeo fimbriatus* (Bhilaji). Then followed *Labeo rohita* (Rohu), *Wallagonia attu* (Pahadi), *Ophicephalus* (Marrel), *Mystus seenghala* and *Catla catla* (Bavoos). There are, besides, other small fishes which are in equally good demand. A welcome variety from these fishes is provided by a large range of fresh water prawns (*Palaemon* sp.). These are available almost throughout the year and in specially fair abundance during the cold season. They grow to a large size.

A list of the fishes found in Ahmedabad, was published by Mr. H. G. Acharya in the *Bombay Natural History Society's Journal*, Vol. 40, p. 765. His list recorded 25 species, but the number falls far below the number contained in a list prepared by us. We have identified 46 different species.\* These were collected at diffe-

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\* *Labeo potail* (Sykes), *Cirrhina cirrhosa* (Bloch.), and *Barbus arulius* (Jerdon) included in Acharya's list have, however, not been met with by us.

rent times of the year, and the list might not yet be fully complete, as there may be other small fishes which we might not have come across. The list of the fishes found by us is given below with both scientific and local vernacular names.—

## LIST OF FISHES OF AHMEDABAD.

<i>Scientific name.</i>		<i>Local name.</i>
Order :—ISOSPONDYLI.		
Family :—NOTOPTERIDAE.		
1. <i>Notopterus notopterus</i> (Pallas).	...	... Patre, Patra.
Order :—OSTARIOPHYSI.		
Sub-order :—SILUROIDEA.		
Family :—HETEROPNEUSTIDAE.		
2. <i>Heteropneustus fossilis</i> (Bloch.).	...	... Shingi.
Family :—SILURIDAE.		
3. <i>Callichrous bimaculatus</i> (Bloch.).	...	... Tamolana, Goongawaree.
4. <i>Wallagonia attu</i> (Bloch.).	...	... Pahadi, Padin.
Family :—SCHILBEIDAE.		
5. <i>Clupisoma garua</i> (Ham.).	...	... Goongawaree.
Family :—BAGRIDAE.		
6. <i>Mystus cavasius</i> (Ham.).	...	... Katiya.
7. <i>Mystus seenghala</i> (Sykes).	...	... Shingala.
Sub-order :—CYPRINOIDEA.		
Family :—CYPRINIDAE.		
Sub-family :—ABRAMADINAE.		
8. <i>Chela clupeoides</i> (Bloch).	...	... Chilli, Chal or Chaliya.
9. <i>Chela phulo</i> (Ham.).	...	... do
10. <i>Laubuca laubuca</i> (Ham.).	...	... Munaya.
Sub-family :—RASBORINAE.		
11. <i>Barilius bendelisis</i> (Ham.).	...	... Murakhi.
12. <i>Danio devario</i> (Ham.).	...	... Melwa.
13. <i>Rasbora daniconius</i> (Ham.).	...	... Munava.
14. <i>Esomus danrica</i> (Ham.).	...	... Rajna.
Sub-family :—CYPRININAE.		
15. <i>Amblypharyngodon mola</i> (Ham.).	...	...
16. <i>Barbus</i> (Tor) khudree Sykes.	...	... Bhasira, Kudna.
17. <i>Barbus</i> (Tor) Mussullah Sykes.	...	... Bhasera Kudana.
18. <i>Barbus</i> (Puntius) sarana (Ham.).	...	...
18a. <i>Barbus</i> (Puntius) chrysopoma (C + V).	...	... Daraii.
19. <i>Barbus</i> (Puntius) ticto (Ham.).	...	... Dhebari.
20. <i>Barbus</i> (Puntius) sophore (Ham.).	...	... Dhebari.
21. <i>Barbus</i> (Puntius) arenatus (Day).	...	... Dhebari.
22. <i>Barbus</i> (Puntius) vittatus (Day).	...	... Dhebari.
23. <i>Labeo ariza</i> (Ham.).	...	...
24. <i>Labeo rohita</i> (Ham.).	...	... Rohu.
25. <i>Labeo calbasu</i> (Ham.).	...	... Kanshi, Kalavat, Kalot.
26. <i>Labeo fimbriatus</i> (Bloch.).	...	... Bhilaji.
27. <i>Labeo dussumieri</i> (C + V.).	...	... Kursa.
28. <i>Labeo boggut</i> (Sykes).	...	...
29. <i>Labeo angra</i> (Ham.).	...	... Fattarchatu, Golachi or Goheri.

Scientific name.		Local name.	
30. <i>Cirrhhina mrigala</i> (Ham.)	...	...	Nagari.
31. <i>Cirrhhina reba</i> (Ham.).	...	...	Murakhi.
32. <i>Cirrhhina latia</i> Day.	...	...	Bhagana.
33. <i>Rohtee cotio</i> (Ham.).	...	...	Moyala.
34. <i>Catla catla</i> (Ham.).	...	...	Bavoos or Baas
Family :—COBITIDAE.			
35. <i>Lepidocephala thermalis</i> (C. V.).			
36. <i>Nemachilus botius</i> (Ham.).	...	...	...
Order :—SYNENTOGNATHI.			
Sub-order :—SCOMBRESOCOIDEA.			
Family :—XENENTODONTIDAE OR BELONIDAE.			
37. <i>Xenentodon concila</i> (Ham.)	...	...	Kutharva, Saravati, Kagada.
Order :—MICROCYPRI (Cyprinodontes).			
Sub-order :—POECILIOIDEA.			
Family :—CYPRINODONTIDAE.			
Sub-family :—FUNDULINAE.			
38. <i>Aplochilus blockii</i> Arnold	...	...	Dindiya.
(= <i>Panchax parvus</i> S. Raj 1916).			
Order :—PERCOMORPHI.			
Sub-order :—PERCOIDEA.			
Family :—AMBASSIDAE.			
39. <i>Ambassis nama</i> (Ham.)	...	...	Chandava, Kathayya, Kathonja.
40. <i>Ambassis ranga</i> (Ham.).	...	...	...
Sub-order :—GOBIOIDEA.			
Family :—GOBIIDAE.			
41. <i>Glossogobius giuris</i> (Ham.).	...	...	Modu.
Sub-order :—OPHICEPHALOIDEA.			
Family :—OPHICEPHALIDAE.			
42. <i>Ophicephalus punctatus</i> Bloch.	...	...	Daku, Kadwa.
43. <i>Ophicephalus striatus</i> Bloch.	...	...	Marel, Saval.
44. <i>Ophicephalus marulius</i> Ham.	...	...	Marel, Saval.
Order :—OPISTHOMI.			
Family :—MASTACEMBELIDAE.			
45. <i>Mastacembalus armatus</i> (Lacep.).	...	...	Vam.
46. <i>Mastacembalus pancalus</i> (Ham.).	...	...	Ghepali.

### Occurrence of *Catla*:

The presence of *Catla* in Ahmedabad, as recorded in the list, is a fact of the greatest significance, as the fish is invaluable for rural pisciculture. Its occurrence in Ahmedabad, along with Rohu and Mirgal, ensures a source of supply of fingerlings for fresh water fisheries elsewhere in the Bombay Province, and obviates the need, so long felt, of importing fingerlings from Patna, Madras etc.

The generally accepted view so far had been that *Catla* did not at all occur in the Bombay Province. Day, no doubt in his monumental work on the fishes of India, mentions that the fish is to be found throughout India, but the records and reports of subsequent investigators never confirmed the occurrence of the fish in the westerly flowing rivers of the Indian peninsula.

Sir Reginald Spence and S. H. Prater in their 'Game Fishes of Bombay' observed that the fish occurred in the Bombay Presidency, but did not mention the locality where it was available. Acharya (1939), in his list of fishes, referred to above, does not also mention this fish. The first reference to the fish is by Dr. S. T. Moses, Director of Fisheries, Baroda, who in 1941, included the fish in his 'Statistical Account of the Fish Supply of Baroda City.' His account contains the significant observation that the fish came from Mehmedabad. This area was accordingly continuously surveyed by the present authors, whose investigations have definitely established that the fish occurs not only in the Sabarmati but also in its tributaries Hathmati, Khari, Vatrak, Meshwa, and in the adjoining reservoirs.

Catla is a fish whose favourite habitat is wide and deep river. Now, the rivers round about Ahmedabad, cannot be considered to be deep. They are, in fact, shallow and small, but what has enabled the fish to overcome the disadvantages of this unfavourable habitat, are the dams constructed across the channels of the rivers. Fairly deep pools are usually to be found at the bases of such dams and weirs and they provide makeshift abodes for the fish until the rivers are again in spate. These pools enable the fish to survive and tide over the days of the fierce summer when the waters of the rivers otherwise almost dry up. Some of the natural reservoirs also fulfil the same purpose as the pools at the bases of the dams and weirs.

#### *Bokh Reservoir.—*

One such reservoir, namely the Bokh reservoir, at Prantij, (vide map attached) has been of inestimable value to the fisheries of Ahmedabad. Its perennial supply of water and its connection with the riverine system of northern Gujarat render it an important source of fish, particularly Catla, so much so that it is universally described in Gujarat as the home of Catla in that area. It is really a haven where fish can breed and are assured of plentiful water and adequate protection. The water all along the edge of the reservoir is comparatively shallow and thickly covered with *Typha* (Elephant grass or Bulrush). Moreover, such submerged plants as *Hydrilla*, *Ceratophyllum* and *Vallisneria* which are largely distributed over a wide stretch of water serve to impede fishing and afford good refuge specially to the baby fish. The Bokh has various remarkable features and its general appearance presents a fine problem in the physiography of the district. Here, it would not be out of place to refer to the description of the reservoir given in the Gazetteer of Ahmedabad district, which says: 'the Bokh, which literally means a fissure or chasm, is a broad and deep depression which begins near the meeting of the Hathmati and Sabarmati, and runs south through Prantij. It is a chain of pools and morasses, the largest sheet of water in it, called the large Bokh, being about 156 acres in extent and averaging 30 ft. in depth. The next in size, called the small Bokh, and lying opposite the town of Prantij covers about 35 acres and is said to average 4 feet in depth'.

The reservoir is at present roughly two and a half miles south of the Hathmati river, which evidently had in times gone by been a part of the river, coursing due south to join the Khari. Even now the reservoir is fed from the Hathmati by a canal which starts at Himatnagar, the water being led to the reservoir by a feeder channel from the main canal which ultimately joins the Khari. The overflow from the Bokh during the monsoon is impounded by the dam at Limbla, and this water which would otherwise have run to waste is during the latter part of the monsoon led into the Khari by a canal. The Khari itself is dammed at Raipur about 12 miles north east of Ahmedabad, and the impounded water is used to feed the network of tanks, e.g. Chandola, Kankaria, Gob-halej, Wasai, Aslali, Jetapur etc. The Khari along with other rivers meets the Sabarmati lower down at Vautha. The entire Ahmedabad district is liable to severe floods during the monsoon when the rivers are in heavy spate. Aquatic life is thus distributed over the widely separated tanks and reservoirs by streams running from the heavily submerged tracks. Thus the Bokh is the link connecting the three main rivers of the area, namely, the Hathmati, Khari and Sabarmati. The Bokh was originally about 30 feet deep, but yearly has been becoming shallower as the silt which finds its way into it is not washed away during the floods. The dam at Limbla may perhaps in some measure be responsible for the siltage.

#### *Breeding Grounds.—*

The canals feeding the Bokh reservoir from the Hathmati provide during the time it is in flood an ideal nursery for fish from the reservoir itself to breed. The fish, which consists of such valuable carps as Catla, Rohu, Mirgal and Calbasu, has in flood times the ideal environment for breeding as its natural tendency at breeding time is to move upstream, the two feeder canals, from the Hathmati to the Bokh, serve as depositories for reproductory products of fish of the reservoir. These two stretches of water must evidently be the breeding grounds for in them have been noticed fingerlings of the aforesaid varieties of carps.

As the flood level in these two stretches of water subsides the fry and fingerlings are washed back into the reservoir, from which they later distribute themselves far and wide over the various rivers inter-connected as they are by network of canals.

#### *Destruction of fish.—*

Fishing in the Bokh is not prohibited, but is generally not vigorous during the major part of the year, the configuration of the reservoir presenting certain natural difficulties to the fishermen. The reservoir thus serves as a natural sanctuary for the fish. Both the reservoir and the feeder canal are not, however, equally safe to the fishes during the commencement of the monsoon, when they expose themselves to easy capture while they agitatedly move up the comparatively shallow waters of the feeder canals for breeding. A vivid description of the fate that befalls these fishes

as they move up from the reservoir into the feeder canals and further upwards into the main canal from the Hathmati is contained in the Ahmedabad Gazetteer which records as follows:—

‘In Prantij when flooded after heavy fall of rain, people swarm the Bokh wading about and with arrows tied in harpoon fashion with long string to their bows kill great numbers of fish. Fishing by torchlight is common, Kolis, Wagharies killing the fish by spearing and netting and Pendarias by beating with thick sticks. Damming, driving and poisoning with *Coculus indicus* are also practised’.

Such large-scale destruction of the parent fish before they have a chance to breed, is not without its effect on the supply of fish in the adjoining waters. This fact is also borne out by the observations of the local fishermen who state that the bigger varieties of carps such as Rohu, Catla, Mirgal, are now tending to diminish in numbers.

#### *Remedial Measures.—*

The only remedy to safeguard these fishes, which form in other provinces the mainstay of their piscicultural activities, and to conserve them for comestible purposes, would be to institute systematic control over the present injudicious and indiscriminate fishing in the Bokh reservoir and its environs at the commencement of monsoon. The present system of fishing in and around Ahmedabad is an inversion of the natural order. Fishing should be permitted in reservoirs at the dead ends of canals and in tanks into which fry find their way from the Bokh, for in such sheets of still water well-known carps like Catla, Rohu, Mirgal and Calbasu merely grow and fatten and do not breed. Fishing should, therefore, be allowed in only these sheets of still water, but actually it is forbidden there from religious considerations, a large section of the population being Jains, who are averse to the taking of life. The fish-eating public is thus deprived of a valuable item of food.

The present system of fishing helps neither the fish nor the public. Indiscriminate fishing is carried on in the Bokh and its feeder canals. This must be rigorously prohibited if an increase in the supply of fish is desired, for the Bokh and its feeder canals are in reality the nurseries where these fish rear, thrive and distribute themselves among the network of waterways—some ending in dead ends—which dot the district. The best and most effective protective measure to conserve the valuable carps would be the promulgation of a close season at the Bokh reservoir and its feeder canals for one month from the commencement of the monsoon. All tanks in the Hathmati and Kharicut canal system should be thrown open to fishing. These steps will not only enable the adult fishes to thrive and breed undisturbed in the Bokh and its feeder canals but also eventually facilitate a wider and more abundant distribution of fry in canals and tanks and thus increase the fish supply.

## SOME NEW INDIAN LITHOBIIDAE.

BY

CAPT. H. J. C. LARWOOD, M.SC., F.Z.S., A.E.C.

(With 4 text figures)

While serving in India I have been able to make a small collection of *Myriapoda*, first around Dehra Dun, U.P., and then in Bundelkhand, C.I. It will readily be understood that service in the Army makes it difficult to investigate the collection adequately, and up to this time I have been able to consider only the *Lithobiidae*. The results are, however, of sufficient interest to merit a short note.

As late as 1892, Pocock stated<sup>4</sup> that none of this family had been recorded from India, although in 1890-91 he published an account<sup>3</sup> of two new species from Burma. In 1917 Silvestri<sup>5</sup> described four species and a variety of *Lithobius* from India (Assam, Darjeeling, N. Bengal and N. W. F. Province), and a new species of Henicopidae from Trichinopoly. His list did not include *Lithobius sculpturatus* which had been described<sup>6</sup> in the meanwhile by Pocock from Kodaikanal and Madras.

In his paper, Silvestri stated that although the fauna of India seemed to be poor in Lithobiidae, he considered that collecting in temperate regions would probably yield new forms. The truth of this is borne out by the following paper, although two of the present species come from a region which is scarcely temperate. It is worth noting, however, that both of these were taken under stones within 50 feet of the edge of a lake, and that one, *Lamyctes lani*, was found there only for a few days during the monsoon rains, and that the other *Archilithobius birmanicus* var. *chandellensis* could not be rediscovered after the winter rains had ceased. It would appear that both are very sensitive to humidity.

I wish to express my gratitude to the following gentlemen: Mr. J. C. M. Gardiner, Mr. A. E. Foot, Lt-Col. J. Steel Harvey, I.A., Dr. S. Higginbottom and above all, to Dr. Baini Prashad.

### LITHOBIIDAE.

#### *Lithobiinae.*

#### *Archilithobius glenniel* sp. n. (Fig. 1 a-k)

Colour greenish-brown above, head and posterior segments of a more reddish hue, tergites somewhat mottled, legs and underside pale. Surface finely granulate.

Tergites 1, 3, 5 with postero-lateral corners rounded, posterior margin slightly emarginate; 2, 4, 6 short, posterior margin straight; 7 with subrectangular corners and posterior margin straight or slightly convex; 8, 10, 12, 14 tapering towards the rear, angles rounded, emarginate behind; 9, 11, 13 with posterior margin straight. Terminal segment rather semi-circular in outline, posterior margin only feebly emarginate. A distinct marginal furrow visible in tergites 1, 3 and 5 is less clear in succeeding segments.



Head slightly longer than broad; marginal furrow parallel to posterior margin. Ocelli seven in number arranged as in the figure. (In the Dehra Dun specimens there appear to be 8 ocelli.)

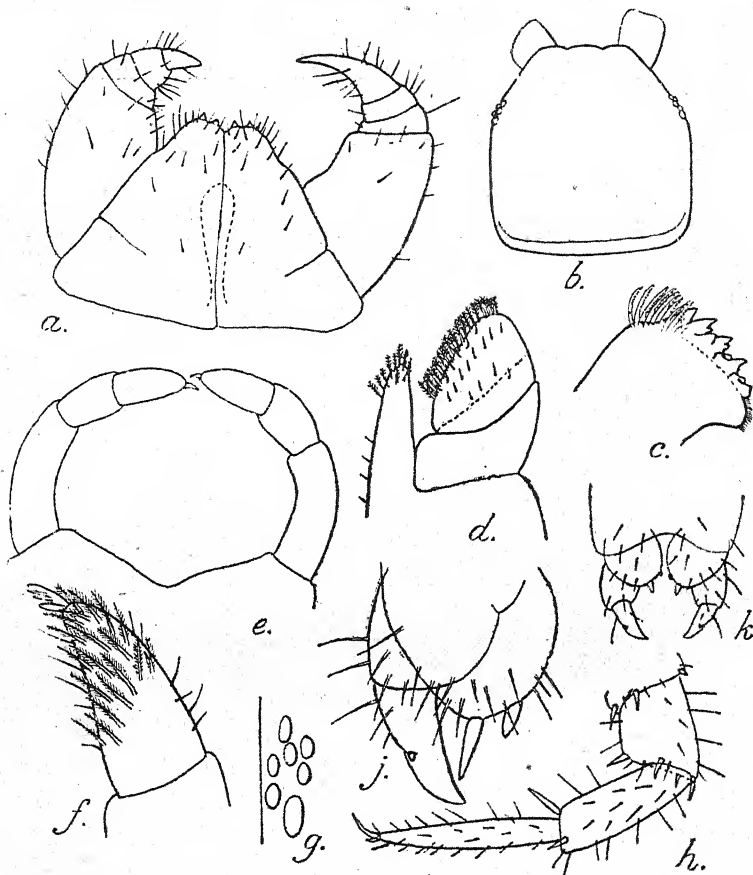


Fig. 1. *Archilithobius glenniei*.

(a) Forcipules (out claw undergoing regeneration); (b) head; (c) mandible; (d) 1st maxilla; (e) 2nd maxilla; (f) 2nd maxilla last segment; (g) ocelli, left side; (h) P. 1. distal part; (i) genital appendages of female; (k) genital Chakrata specimen.

Antennae: 20-23 segmented, setose, 10th segment  $1\frac{1}{2}$  times as long as broad, last segment twice as long as broad.

Mandibles of the usual form.

1st Maxilla: outer lobe fringed with about 23 plumose setae arranged in a double row; inner lobe surmounted by a dozen smaller plumose setae.

2nd Maxilla: terminal segment about twice as long as broad with some 30 plumose setae on the anterior face and non-plumose setae elsewhere. Claw with two spines and a small secondary claw.

Forcipules with 2+2 teeth and an additional seta on each side; precoxa narrowed distally, external margin concave.

Spination is of doubtful diagnostic value on account of the variation— which obtains—the opposite sides of the same specimen are occasionally found to be differently armed. For instance, the coxae of P. 14 and P. 15 of all specimens, bear a single spine, yet on one side of one specimen, two spines

arise from a common base. The most usual armature, however, is as follows:

P. 1.  $\frac{0\ 0\ 1\ 2\ 1}{0\ 0\ 2\ 2\ 1}$  and P. 14.  $\frac{1\ 0\ 3\ 2\ 0}{0\ 1\ 3\ 2\ 1}$ . Only a single P. 15 was found

and it was armed thus:— $\frac{1\ 0\ 3\ 1\ 0}{0\ 1\ 3\ 2\ 1}$ . A minute secondary claw was present on all these appendages.

Genital appendages—female: external claw robust with the outer margin sinuate and a distinct tooth about midway. Internal lobe with two teeth, the outer about as long as the inner, but both robust. In the specimen from Chakrata, the inner tooth is less than half the size of the outer.

Genital appendages—male: rudimentary.

Coxal pores: 2 (or 3); 4; 4; 4 (or 3) small, circular.

Length: 11 mm.

Locality: 1 ♀ Mussoorie: under stone, shady 23: 11: 42. 7,000 ft.

2 ♂♂ Dehra Dun: under stone. Sept. 42. 2,200 ft.

1 ♀ Chakrata, from cave named Moila No. 2. Collected by Brig. E. A. Glennie. May 43.

This species is closest to *L.(A). tactus* Silv. and *L.(A). erraticus* Silv. from Chitral (N.W.F. Province). From the former, it can be distinguished by (1) the fewer ocelli, (2) fewer coxal pores, (3) the form of the genital appendages of the female. The present species differs from *L.(A). erraticus* in the following characters: (1) more numerous coxal pores; (2) the tarsi of P. 1-12 are not biarticulate as Silvestri<sup>9</sup> claims those of his species to be, although a pale transverse line is sometimes discernible across the mid-line of the tarsus; (3) the genital appendages of the female are of a different form—Silvestri makes no mention of the very conspicuous tooth on the outer margin of the external claw.

I have pleasure in naming this species after Brig. E. A. Glennie, D.S.O. The specimen taken by him from the Moila cave at Chakrata certainly belongs to this species in spite of the small deviation in the form of the female genital appendage referred to above. The chance migration of such lucifuge creatures into such an environment is not surprising.

#### *Archilithobius* sp. (Fig. 2 a-b)

Colour dark brown above, lighter beneath, head and last tergite orange; each tergite with the posterior border and middle line darker.

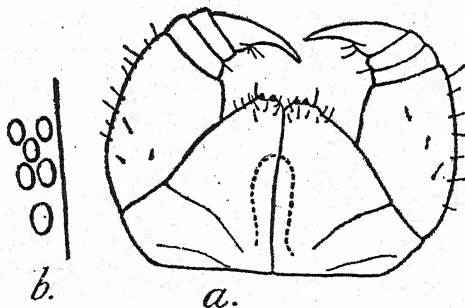


Fig. 2. *Archilithobius* sp.

(a) Forcipes; (b) Ocelli right side.

Tergites similar in form to *A. glenniei*.

Head broader than long, furrow parallel to posterior margin.

Ocelli: six, arranged as shown.

Antennae and mouth parts as for *A. glenniei* except that the last segment of mandibula has fewer plumose setae.

Forcipes: anterior margin convex, 2+2 teeth and seta; claw short.

Spinulation: P. 1.  $\frac{0\ 0\ 1\ 2\ 1}{0\ 0\ 2\ 2\ 1}$ ; P. 14.  $\frac{1\ 0\ 3\ 1\ 1}{0\ 1\ 3\ 2\ 1}$ ; P. 15. missing. P. 1. and P. 14 both have a small secondary claw. Coxae of P. 14 and P. 15 dorsal spine.

Genital appendages—male: rudimentary.

Coxal pores: 2; 3; 3; 3.

Length: 9.0 mm.

Locality.—A single specimen (male) of a species of *Archilithobius* was forwarded to me by Brig. Glennie. It was taken by Lt.-Col. G. N. Osmaston, R.E., near the top of Harimukh Mountain, Kashmir, at a height of 16,000 ft. in July 1943.

This specimen differs from *A. glenniei* in (1) the form of the head, (2) number of ocelli, (3) shape of forcipules and (4) number of coxal pores. From *A. erraticulus* Silv. it can be distinguished by (1) the fewer ocelli, (2) the form of the forcipules and (3) the presence in all legs of an undivided tarsus. Until further material is available it would be unwise to state anything more definite than that the example does not fit in with any previously described species.

***Archilithobius birmanicus* var. *chandellensis* nov. (Fig. 3 a-f)**

Colours Reddish-brown above, last tergite and underside paler. Surface rugose.

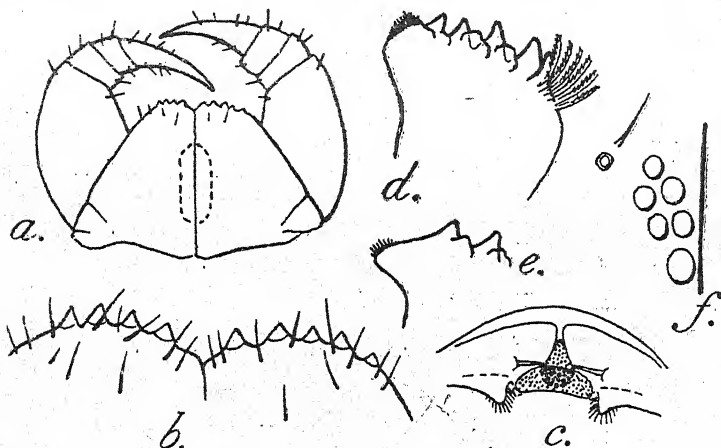


Fig. 3. *Archilithobius birmanicus* var. *chandellensis*.

(a) Forcipules; (b) Forcipules teeth; (c) labrum (forshortened); (d) mandible; (e) mandible, another specimen; (f) ocelli, right side.

Tergites 1, 3, 5 with rounded postero-lateral corners, feebly emarginate; 2, 4, 6, 7 subrectangular with posterior margin straight; 8, 10, 12, 14 somewhat emarginate, with rounded corners and lateral margins increasingly convergent towards the rear; 9, 11, 13 straight, corners rectangular, not sharp. Head longer than broad; posterior marginal furrow broader in mid-line. Ocelli not very clear in the specimens examined; apparently 6 in number, arranged as in figure.

Antennae.—19-20-segmented, moderately setose, last segment 3 times as long as broad, 10th segment  $1\frac{1}{2}$  times as long as broad.

Mandibles normal, teeth robust, with setose rectangular process on inner face. This process is, however, much reduced in another example.

1st Maxilla with about 15 plumose setae on the inner margin of the outer lobe and numerous plumose setae on the inner lobe.

2nd Maxilla.—Last segment with less than 20 plumose setae and furnished with a single claw with 3 processes.

Forcipules with broad, convex precoxa bearing 5+5 teeth (in one specimen 5+4); claw slender.

Spinulation.—P. 1.  $\frac{00311}{00121}$ ; P. 14.  $\frac{10310}{01330}$ ; P. 15.  $\frac{10210}{01320}$   
P. 14. and P. 15. have each a small secondary claw; part of limb distal to tibia with abundant small pores.

Genital organs of male rudimentary.

Coxal pores.—2 (or 3); 4; 4; 3.

Length.—8.0 mm.

Locality.—margin of Dhobelatal, near Nowgong (Bundelkhand), under stones, moist, with grass around. Jan. 43. 6 specs—all male.

Of the species recorded previously from the Indo-Australian region, only *A. sumatanius* Silv. and *A. birmanicus* Poc. have more than 3-4 teeth on the forcipules. The former has 7 and the latter 5-6. The present species is very close to *A. birmanicus*,—antennae, ocelli, tergites and coxal pores all agree with Pocock's description<sup>3</sup> which is brief and without figures. The chief points of difference are the number of teeth on the forcipules and the ventral armature of P. 15. (given as 1, 1, 1, 0, which I take to be 0, 0, 1, 1, 1, in the usual notation). As I have not seen the Burma specimens, and as there is no female in the present collection, I consider it more prudent to regard my specimens, for the time being at least, as belonging to a variety of *A. birmanicus*. Further collecting will no doubt elucidate the affinities of these species.

#### HENICOPINAE.

Atters lists 4 species and 1 variety of the genus *Lamyctes*:

(1) *L. africana* (Poc.)—S. W. Australia, Caffraria, Capland, Cameroons, St. Paul.

(2) *L. albipes* (Poc.)—Java.

(3) *L. emarginata* (Newp.)—New Zealand.

(4) *L. fulvicornis* Mein.—S. W. Australia, Europe, N. America, E. Africa.

(5) *L. fulvicornis* var. *hawaiiensis* Silv.—Hawaii, Kona.

The genus has not previously been recorded from India.

#### *Lamyctes liani* sp. n. (Fig. 4 a-j)

Colour reddish-brown; antennae, anterior part of head and hindmost tergite orange-brown. Underside pale. Surface finely granulate.

Tergites 1, 3, 5 with rounded postero-lateral corners, very slightly emarginate; 2, 4, 6, 7 with posterior corners sub-rectangular, posterior margin straight; 8, 10, 12, 14 with rounded posterior angles, distinctly emarginate, segments converging posteriorly; 9, 11, 13 with posterior margin straight. All tergites with a distinct marginal furrow.

Head about as broad as long; marginal furrow parallel to posterior margin.

Ocelli single, large, with purple pigment. [Traces of the same pigment were to be found scattered throughout the body, which is interesting in view of the fact that Chamberlin refers to the presence of a similar pigment in *L. Dolichopus* from Salt Lake County, N. America (Chamberlin, R. V. Proc. U.S. Nat. Mus. XXIV No. 1270, p. 798)].

Antennae almost reaching the posterior border of the 5th tergite; 29 segments, covered with short setae; last segment slender, 3-4 times as long as broad; 10th segment considerably broader than long.

Mandibles with conspicuous tooth at inner distal angle.

1st Maxilla of usual type: outer lobe fringed with 20 plumose setae; inner lobe with about 6 non-plumose setae.

2nd Maxilla—last segment with about 13 plumose setae; single claw with two lateral spines. [In his conspectus of the genus, (Naturh. Tidsskr. (3), V. 1868. p. 266) Meinert states that the setae are simple. This is not so in this species].

Forcipules with broad precoxal region; external margin obtuse-angled and slightly concave; apical margin with 3+3 teeth, the outermost on each side being considerably smaller than the other two.

Spinulation.—P. 1.  $\frac{0\ 0\ 0\ 0\ 0}{0\ 0\ 0\ 0\ 0}$ ; P. 14.  $\frac{0\ 0\ 0\ 0\ 0}{0\ 0\ 0\ 0\ 0}$ ; P. 15.  $\frac{0\ 0\ 0\ 0\ 0}{0\ 0\ 0\ 0\ 0}$

On P. 1. there is a pseudo-spine formed by an extension of the integument of the dorsal side of the prefemur. Coxae of P. 14. and 15. without spine.

P. 1, P. 14. and P. 15. with small secondary claw. Legs are covered with numerous setae, but no pores occur. P. 1-12 with undivided tarsus, P. 13-15 with two-segmented tarsus, but division is not always well-marked.

First leg-bearing segment with spiracle.

Genital organs—female: basal segment with 2 elongated teeth, the inner shorter than the outer; terminal claw narrowed distally, markedly curved and with a longitudinal incision on the inner side.

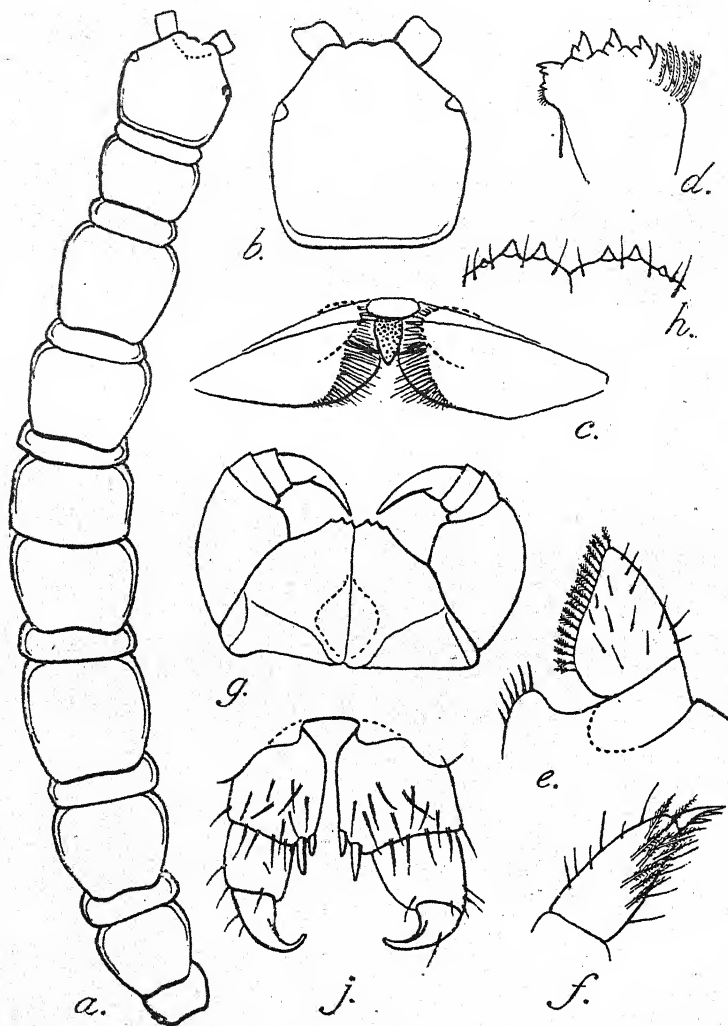


Fig. 4. *Lamyctes liani* sp. n.

(a) entire; (b) head; (c) labrum; (d) mandible; (e) 1st maxilla; (f) 2nd maxilla, last segment; (g) forcipules; (h) forcipules, teeth; (i) genital appendages of female.

Coxal pores: 2; 2; 2; 2; 2; or 3; 3; 3; 3.

Length—7.0-8.0 mm.

Locality—margin of Dhubelatal, near Nowgong. Under stones, moist gravel 21st and 24th July 43.

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## EXPLANATION OF FIGURES.

Fig. 1. *Archilithobius glenniei*.—(a) Forcipules (one claw undergoing regeneration), (b) head, (c) mandible, (d) 1st maxilla, (e) 2nd maxilla, (f) last segment of 2nd maxilla, (g) ocelli—left side, (h) P. 1, distal region of limb, (i) genital appendages of female, (k) the same, specimen from Chakrata.

Fig. 2. *Archilithobius* sp.—(a) Forcipules, (b) ocelli—right side.

Fig. 3. *Archilithobius birmanicus* var *chandellensis*.—(a) Forcipules, (b) teeth of forcipules, (c) labrum (foreshortened), (d) mandible, (e) mandible of another specimen, (f) ocelli—right side.

Fig. 4. *Lamyctes liani*.—(a) entire, (b) head, (c) labrum from below, (d) mandible, (e) 1st maxilla, (f) last segment of 2nd maxilla, (g) forcipules, (h) teeth of forcipules, (j) genital appendages of female.

## ANNOTATED LIST OF CROP PESTS IN THE BOMBAY PROVINCE.

BY

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## INTRODUCTION.

Economic entomology is very intimately associated with the crop production, therefore some knowledge of the more important pests is of the greatest significance. In the province of Bombay however, much attention could not be devoted to the study of various pests since the staff engaged was small and mostly occupied in teaching. Nevertheless, it has now been realised that the first essential necessity is to determine the identity and the activities of the insect foes, responsible for damaging our crops. The present publication therefore, aims at supplying such information to cultivators, garden-owners, district workers, propaganda officers, the revenue authorities, and also to students in the Agricultural College

and schools, regarding the insects, found infesting various crops in our fields.

Additional data in the form of life histories, seasonal activities, nature and extent of damage and above all, the control measures, is highly desirable but must be deferred till first-hand information under local conditions, is available. Efforts are being made to remedy these deficiencies and the results of our further investigations will be published in the second contribution from this Department.

At present however, it is considered desirable that data should be available about the pests, responsible for the damage to various crops, and as far as possible about their seasonal activities. With this view an almost complete list of the pests of our province is arranged under crop heads, and brief notes appended.

### Sugarcane.

*Saccharum officinarum* is planted in January to March and June and harvested from December to May.

#### A. ATTACKING SETS AND ROOTS.

1. White ants—*Termes* sp. (*Termitidae*). Major pest all over the province. The workers tunnel into the roots to which the plants succumb.
2. Cockchafer—*Anomala varians* O. (*Rutelidae*). Minor pest, the grubs feed on the roots; active from April to June.

#### B. LEAF FEEDING.

##### I. Biting :

1. Grasshopper—*Hieroglyphus banian* Fb. var. *elongata* (*Acridiidae*). Major pest specially in Deccan. Nymphs and adults feed on leaves; only one brood active from June to October.
2. Army worm—*Cirphis unipuncta* H. (*Noctuidae*). Major pest all over the province. Caterpillars move in swarms and feed on leaves; there may be two to three generations from June to November; hibernates as pupa in the soil.

##### II. Sucking :

1. White-flies—*Aleurolobus barodensis* W. and *Neomaskellia bergi* S. *Aleyrodidae* Minor pest practically all over the province. Nymphs feed on the sap which might result in withering of the leaves; active from July to December giving rise to formation of conspicuous black mould.
2. Leaf hopper—*Pyrilla aberrans* Kby. (*Fulgoridae*). Major pest all over the province. Nymphs and adults feed on the sap and cause withering of the leaves. 'Honey dew' secreted by the insects develops black mould which gives sooty appearance to leaves. Active from April to May and from August to February.
3. Mealy bug—*Trionymus sacchari* Gr. (*Coccidae*). Minor pest in Deccan. Nymphs and adults feed at the base of the leaves and consequently the crop loses vigour.
4. Black bug—*Assamia moesta* Westw. (*Fulgoridae*). Minor pest, probably active from July to December.

#### C. BORERS.

1. Stem borer—*Argyria sticticrasis* Hamp. (*Pyralidae*). Major pest all over the province. The caterpillars bore into the stem and the plants in earlier stages may die; active from April to August during which period, three to four generations may occur.



2. Top-shoot borer—*Scirpophaga nivella* F. (Pyralidae). Minor pest recorded from Deccan area; caterpillars bore from the top and work downward; shoots may assume bunched appearance.

3. Pink stem borer—*Sesamia inferens* W. (Noctuidae). Occasionally may assume the status of a major pest. Caterpillars bore into the stem; there may be 4-6 generations in a year; active from July to February.

#### Jowar.

*Andropogon sorghum*. Sown in June and September to November, and harvested from November to December and February-March. Fodder crop in March-June.

#### A. ATTACKING ROOTS.

1. White ants—Termites (*Termitidae*). Major pest. (vide Sugarcane).
2. Cockchafer—*Anomala varians* O. Minor pest. (vide Sugarcane).

#### B. LEAF FEEDING.

##### I. Biting :

1. Lucerne caterpillar—*Laphygma exigua* Hb. (Noctuidae). Minor pest; the caterpillars feed on leaves especially during the months of January and February.

2. Katra—*Amsacta moorei* B. (Arctiidae). Major pest, recorded in North Gujarat. Caterpillars defoliate all the plants. There is only one generation during June-July; hibernates as pupa in the soil.

3. Deccan wingless grasshopper—*Colemania sphenariodes* Bol. (Acridiidae). Major pest attacking crops only in Karnatak and Deccan. Both nymphs and adults feed on leaves, and there is only one generation from June to October.

4. White banded grasshopper—*Epacromia dorsalis* Thumb. (Acridiidae). Major pest in Deccan only. Both nymphs and adults feed on leaves and defoliate the germinating seedlings.

5. Surface grasshopper—*Chrotogonus lugubris* B. (Acridiidae). Major pest, recorded from all over the province. Nymphs and adults feed on leaves, and the pest is active almost throughout the year. It also damages various other crops such as Bajri, maize, etc.

6. Army worm—*Cirphis unipuncta* H. Minor pest. (vide Sugarcane).

##### II. Sucking :

1. Aphides—*Aphis maidis* F. (Aphidiidae). Major pest active from August—February. The insects suck the plant juice and the plants lose vitality. Various predators and black ants are always associated with the attack.

2. Green bug—*Nezara viridula* L. (Pentatomidae). Minor pest found on tender shoots and earheads. The attack is not very serious.

3. Jowar stem bug—*Pundaluoya simplicia* Dt. (Fulgoridae). Major pest, invariably found on the tender shoots. Nymphs and adults feed on the sap which results in withering of the plants; active from August—February.

4. Mites—*Paratetranychus indicus* H. Major pest which gives reddish or rusty appearance to the foliage; active from August—February.

5. Leaf hopper—*Pyrilla aberrans* Kby. Major pest. (vide Sugarcane).

#### C. BORERS.

1. Jowar borer—*Chilo zonellus* S. (Pyralidae). Major pest, practically all over the province. The caterpillars bore into the stem and cause the death of the plant in early stages. There are 4-6 generations from May to February.

2. Pink borer—*Sesamia inferens* Wlk. Major pest. (vide Sugarcane).

3. Stem fly—*Atherigona indica* M. (Anthomyiidae). Major pest all over the province; active from May to February. The maggots bore into the young seedlings and bring about their death.

1. Blister beetles—*Lytta tennicollis* P. and species. (*Meloidae*). Adult beetles feed on blossom and do not allow them to develop into seeds; active from August to October.

2. Khas disease—*Contarinia andropogonis* F. (*Cecidomyidae*). Minor pest. The maggots breed inside the tender ears as a result of which they are hollowed out; active during January—February.

## II. Sucking :

1. Capsid bug—*Calocoris angustatus* L. (*Capsidae*). Minor pest. The nymphs and adults which are just like mosquitoes, feed on the sap as a result of which the grains get shrivelled; active from December—February.

## Maize

*Zea mays*. Sown at any time, harvested 3-4 months after sowing.

### A. ATTACKING ROOTS.

1. White ants—*Termites*. Major pest. (vide *Sugarcane*).

### B. LEAF FEEDERS.

#### I. Biting :

1. Army worm—*Cirphis unipuncta* H. (*Noctuidae*). Major pest. (vide *Sugarcane*).

2. Deccan wingless grasshopper—*Colemania sphenarioides* B. Major pest. (vide *Jowar*).

3. Banded grasshopper—*Epacromia dorsalis* Thumb. (*Acridiidae*). Minor pest. (vide *Jowar*).

4. Katra—*Amsacta moorei* Butl. (*Arctiidae*). Major pest. (vide *Jowar*).

5. Surface grasshopper—*Chrotogonus lugubris* B. (*Acridiidae*). Minor pest. (vide *Jowar*).

#### II. Sucking :

1. Stem bug—*Pundaluoya simplicia* Dt. (*Fulgoridae*). Major pest. (vide *Jowar*).

### C. BORERS.

1. Jowar borer—*Chilo zonellus* S. (*Pyralidae*). Major pest. (vide *Jowar*).

2. Pink borer—*Sesamia inferens* W. (*Noctuidae*). Major pest. (vide *Jowar*).

## Wheat

*Triticum vulgare*. Sown in September to November and harvested from February—March.

### A. ROOT FEEDERS.

1. White ants (*Termites*). Major pest. (vide *Sugarcane*).

### B. LEAF FEEDERS.

1. Aphides. Major pest. (vide *Jowar*).

### C. BORERS.

1. Jowar borer—*Chilo zonellus* S. (vide *Jowar*).

2. Pink borer—*Sesamia inferens* W. (vide *Jowar*).

## Bajri.

*Pennisetum typhoideum*. Sown in June and harvested from September to October.

A. ROOT FEEDERS.—NONE.

B. LEAF FEEDERS.

I. Biting :

1. Deccan wingless grasshopper—*Colemania sphenarioides* B. Major pest. (vide *Jowar*).
2. Katra—*Anisacta moorei* B. Major pest. (vide *Jowar*)
3. Army worm—*Cirphis unipuncta* H. Major pest. (vide *Jowar*).
4. Hairy caterpillar of Satara—Unidentified. Major pest. only recorded from this district. It is commonly known as 'Lodh'. Caterpillars feed on leaves and there is only one generation a year during July—August. The pest hibernates as pupa, in the soil.
5. Grasshoppers—*Chrotoganus* sp. and *Epacromia* sp. (vide *Jowar*).

II. Sucking : None.

C. BORERS.

1. Jowar borer—*Chilo zonellus* S. (vide *Jowar*)
2. Pink borer—*Sesamia inferens* W. (vide *Jowar*).
3. Stem fly—*Atherigona indica* M. (*Anthomyiidae*) (vide *Jowar*.)

D. GRAIN FEEDERS.

1. Blister beetles—*Lytta* sp., *Zonabris* sp. etc. (*Meloidae*). Major pest. (vide *Jowar*)

Paddy.

*Oryza sativa*. Sown in June; transplanted in July—August; harvested from November to January.

A. ATTACKING ROOTS.

1. Cockchafer—*Anomala varians* O. Minor pest; (vide *Sugarcane*).
2. Cockchafer—*Phyllognathus* sp. (*Dynastidae*). Minor pest.

B. ATTACKING SEEDLINGS.

1. Crabs—*Paratelphusa* sp. (*Crustacea*). Major pest in Konkan area. Both adults and young ones feed on the nursery as well as the transplanted seedlings. Their burrowing in the bunds causes leakage of water; active during the rainy season.

C. LEAF FEEDING.

I. Biting :

1. Swarming caterpillar—*Spodoptera mauritia* B. (*Noctuidae*). Major pest all over the rice growing tract. The caterpillars feed on rice and other grasses. Only one generation during June—August. The pest hibernates as pupa in the soil.
2. Army worm—*Cirphis albistigma* M. (*Noctuidae*). Major pest in Ratnagiri district. The caterpillars feed on leaves and the pest hibernates as pupa in the soil. There are 2-3 generations from July-September.
3. Rice hispa—*Hispa armigera* Q. (*Chrysomelidae*). Major pest in Karwar and Belgaum districts. The grubs and adults feed on green matter and cause withering of plants. Both the *Kharif* and *Rabi* crops of paddy are attacked and damaged.
4. Blue beetle of Rice—*Leptispa pygmaea* B. (*Chrysomelidae*). Major pest in Karwar, Belgaum and Ratnagiri districts. Both grubs and adults feed on the green matter and the plants succumb to their attack. Both the *Kharif* as well as the *Rabi* crops are attacked and damaged.
5. Rice grasshopper—*Hieroglyphus banian* Fb. var. *elongata*. Minor pest. (vide *Sugarcane*).
6. Rice butterfly—*Melanitis ismene* C. (*Nymphalidae*). Minor pest. The caterpillars are occasionally found feeding on leaves.

7. Rice skipper—*Chapra mathias* Fb. (*Hesperiidae*). Occasionally the caterpillars are found feeding on leaves.

8. Rice case worm—*Nymphula depunctalis* G. (*Pyralidae*). Minor pest. The caterpillars prepare cases from cut out leaf blades and feed when concealed in the rolls. These are semi-aquatic in habit and two generations are passed from June to August.

## II. Sucking:

1. Rice leaf hopper—*Nephotettix bipunctatus* Fb. (*Jassidae*). Minor pest, only recorded from North Gujarat.

2. Rice mealy bug—*Ripersia oryzae* Gr. (*Coccidae*). Minor pest occasionally found in colonies on the stem under leaf sheaths. The attacked plants are practically devoid of vitality, appear sickly and generally wither out without developing earheads.

## D. BORERS.

1. Rice stem borer—*Schoenobius bipunctifer* Wlk. (*Pyralidae*) Major pest. The caterpillars bore into the stem as a result of which the central growing leaf is killed. When the attack is at flowering stage the bearing is very poor and results in empty earheads. There are 3-4 generations from May to December.

2. Pink borer—*Sesamia inferens* W. Minor pest. (vide Sugarcane).

3. Rice gall-fly—*Pachydiplosis oryzae* W. (*Cecidomyiidae*). Major pest, recorded from Belgaum, Karwar and Ratnagiri districts. The maggots bore into the stem as a result of which hollow outgrowths known as 'silvery shoots' are developed. Such plants do not bear earheads. The pest is active from May to December.

## E. FEEDING ON EARHEADS.

1. Blister beetles—*Lytta* sp. and *Epicauta*. Sp. Minor pest. (vide Jowar)

2. Rice bug—*Leptocorisa acuta* Th. (*Coreidae*). Minor pest, damaging the earheads, met with in Belgaum and Karwar districts. Practically no grains are formed in the attacked inflorescence. Both the *Kharif* and *Rabi* crops are attacked.

## Cotton.

*Cossypium* sp. Sown early in July-August, picking from December to March.

## A. ATTACKING ROOTS.

1. White ants—*Termites*. (vide Sugarcane).

## B. LEAF FEEDING.

### I. Biting :

1. Lucerne caterpillar—*Laphygma exigua* H. Minor pest. (vide Jowar)

2. Surface grasshopper—*Chrotogonus* sp. Minor pest. (vide Jowar)

3. White weevil—*Mylocherus* ~~11-pustulatus~~ var. *maculosus* Fst. (*Curculionidae*). Minor pest. Occasionally found feeding on the leaves. All the immature stages are found in the soil.

4. Bhindi caterpillar—*Acontia* sp. (*Noctuidae*). Minor pest. Occasionally green semi-loopers are found feeding on cotton leaves, the pest is active from June to October. The adult moths have bright lemon yellow wings.

5. Cotton semi-looper—*Cosmophila indica* Gn. (*Noctuidae*). Minor pest. The semiloopers are green but the adults have brownish wings. Considerable damage has been recorded to cotton leaves in Surat district.

6. Cotton semi-looper—*Tarache nitidula* F. (*Noctuidae*). Minor pest. Adults with white wings decorated with dark markings, semilooper dark brown, found damaging the leaves; commonly met with from June to October.

7. Cotton leaf roller—*Sylepta derogata* Fb. (*Pyralidae*). Minor pest occurring all over the province. Caterpillars lead a hidden life in the rolled up

leaves and feed on the green matter. There are 3-4 generations from June to December.

8. Cotton grasshopper—*Cyrtacanthacris ranacea* S. (Acrididae). Minor pest. Both nymphs and adults feed on leaves from June to February.

9. Bud caterpillar—*Phycita infusella* M. (Pyralidae). Minor pest. The caterpillars are found feeding on buds and top leaves. This results in the fading of top shoots. Active from September to November.

## II. Sucking:

1. Red Cotton bug—*Dysdercus cingulatus* Fb. (Pyrrhocoridae). Major pest, sucking the sap from the buds and bolls. Their feeding strains the lint. There are 5-6 generations from August to March.

2. Dusky cotton bug—*Oxycarenus laetus* K. (Lygaeidae). Major pest. The nymphs and adults are found feeding inside the bolls where quite a large number of these insects is seen at a time. There are 4-5 generations from October to March.

3. Cotton aphids—*Aphis gossypii* G. (Aphididae). Major pest. It is found on the under side of the leaves. The infested plants show poor growth or in severe cases they even wither away. The sooty mould develops on the 'honey dew' and interferes with photosynthesis. The pest is active from July to March.

4. Cotton jassid—*Empoasca* spp. (Jassidae). Major pest, found all over the province. The nymphs and adults feed on the sap and reduce the vitality of the plants. Breeding continues throughout the year. Active from July to March.

5. Mealy wings—*Bemisia tabaci* Genn. (Aleyrodidae). Minor pest. Both nymphs and adults feed on the sap and in some severe cases cause the withering of the plant. The pest is noticed in large numbers during November to March, malnutrition results in shedding of flowers and bolls.

6. Mealy bugs—*Pseudococcus* sp. (Coccidae). Minor pest. The fleshy insects covered over with cottony mass, feed on the sap. The pest is active from November to March.

7. Woolly mites—*Eriophyes gossypii*. Minor pest. These are found feeding on the stem and the underside of leaves. Usually these are found covered over with brown woolly fibers as the name indicates. Active from August to February.

## C. BORERS.

1. Spotted boll worm—*Earias fabia* F. and *Earias insulana* B. (Noctuidae). Major pest. The caterpillars are black with white irregular patches. They bore into the top shoots, buds and bolls. The attacked bolls have punctures which are prominent because of the excreta; active throughout the season.

2. Pink boll worm—*Platyedra gossypiella* S. (Gelechiidae). Major pest; caterpillars, pink in colour, they bore into the bolls and feed on seed. Active from September to March.

3. Stem borer—*Sphenoptera gossypii* K. (Buprestidae). Minor pest. The grubs bore into the stem near the ground level and cause slight swelling. In serious cases the attacked plants may die.

## Sann hemp.

*Crotalaria juncea*. Sown in June. Harvested from October to November.

## A. ROOT FEEDERS—NONE.

## B. LEAF FEEDERS.

### I. Biting :

1. Sann leaf caterpillar—*Utetheisa pulchella* L. (Arctiidae). Major pest. The hairy caterpillars feed on leaves and defoliate the plants. Pupation either in the leaf folds or in the soil. There are 3-4 generations from June to September.

### II. Sucking :

1. Leaf hopper—*Empoasca* sp. (Jassidae). Minor pest. (vide Cotton).

## C. BORER.

1. Shoot borer—*Laspeyresia pseulonectis* Meyr. (*Eucosmirae*). Occasionally recorded as a minor pest. The caterpillars bore into the shoots and are active during July and August.

**Tobacco.**

*Nicotiana tabacum*. Seedlings raised from July to August; transplanted in September; harvested from January to February.

## A. ROOT FEEDERS—NONE.

## B. LEAF FEEDERS.

## I. Biting :

1. Surface grasshopper—*Chrotogonus* sp. Minor pest. (vide *Jowar*)
2. Tobacco caterpillars—*Prodenia litura* F. (*Noctuidae*). Minor pest. Black and stout caterpillars are occasionally seen feeding on leaves. Pupation in the soil. There are 3-4 generations from September to January.
3. Cut worms—*Agrotis ypsilon* Rott. (*Noctuidae*). Black and stout caterpillars remain hidden in the soil during day and cut the plants near the ground level at night, and feed on the leaves. There may be 2-3 generations from August to October.
4. Brown cricket—*Brachytrypes portentosus* Licht. (*Gryllidae*). Minor pest. The adults cut the plants near the ground level and feed on them. Damage is serious during September.

## C. BORERS.

1. Stem borer—*Gnorimoschema (Phthorimaea) heliopa* L. (*Gelechiidae*). Major pest. Small caterpillars bore into the stem and may cause the death of the plant. Two generations are passed in a season.

**Potato**

*Solanum tuberosum*. Planted in July and November; harvested in September and February.

## A. LEAF FEEDING.

## I. Biting :

1. Cut worm—*Agrotis ypsilon* Rott. Major pest. (vide *Tobacco*).

## II. Sucking :

1. Leaf hopper—*Empoasca* sp. Major pest. (vide *Cotton*).

## B. BORERS.

1. Tuber moth—*Gnorimoschema operculella* Z. (*Gelechiidae*). Major pest. Dirty white caterpillars bore into the tubers and occasionally the buds. Externally black excreta is seen at the eyes. There are about 4-6 generations throughout the year. The pest is more serious during the hot months.

**Cucurbits.**—Sown in June, October and February; harvested from time to time.

## A. LEAF FEEDING.

## I. Biting :

1. Pumpkin beetles—*Aulacophora abdominalis* Fb. and *Aulacophora excavata* Fb. (*Chrysomelidae*). Major pest. Red and black beetles are seen feeding on leaves which are badly damaged. The germinating seedlings when attacked are practically destroyed. The immature stages are found in the soil. The grubs cause appreciable damage by boring into the roots and stems as well as the fruits which come in contact with the soil. The pest is active from March to October.
2. Epilachna beetle—*Epilachna 28 puncta* F. and *Epilachna 12 puncta* M. (*Coccinellidae*). Major pest. The adults are orange coloured with 12 or 28 black dots on the body, while the grubs are hairy and both the adults and grubs feed on the underside of leaves. The adults eat leaf areas while the grubs feed on the leaf tissue, imparting ragged appearance. There may be 3 generations from July to September.

## II. Sucking :

1. *Aphis malvae* K. Major pest. (vide Jowar)

## III. Feeding on flowers :

1. Banded blister beetles—*Zonabris postolata* Thunb. Minor pest. (vide Bajri).

## B. BORERS.

1. Fruit fly—*Chaetodacus cucurbitae* Coq. *Chaetodacus zonatus* S. (*Trypae-nidae*). Major pest. White legless maggots bore into the fruits and cause their rotting. Pupation takes place in the soil. There may be 6 generations from May to January, but they overlap.

## Cruciferous vegetables.

Both Kharif as well as Rabi.

## I. Leaf feeding :

1. Diamond back moth—*Plutella maculipennis* C. (*Plutellidae*). Minor pest. Slender green caterpillars bite holes and feed on the foliage where they pupate. Active both on Kharif and Rabi crops.
2. Lucerne caterpillar—*Laphygma exigua* Hb. Minor pest. (vide Jowar)
3. Tobacco caterpillar—*Prodenia litura* F. Major pest. (vide Tobacco).
4. Mustard saw-fly—*Athalia proxima* K. (*Tenthredinidae*). Major pest. The grubs are black, which feed on the underside of leaves and drop down with the slightest touch. The damage is done by biting holes and skeletonising the leaves. Active from June to November.

## Brinjal.

*Solanum melongena*. Seedlings raised in June—July, and October—December. Harvested when the fruits are ready.

## A. LEAF FEEDING.

## I. Biting :

1. Epilachna beetle—*Epilachna dodecastima* M. and *Epilachna 28 punctata* F. Minor pest. (vide Cucurbits).
2. Leaf roller—*Eublemma olivacea* W. (*Noctuidae*). Minor pest. The green caterpillar rolls the leaves and leads a concealed life. The pest is commonly met with in the winter crop.

## II. Sucking:

1. Aphis—*Myzus persicae* S. Minor pest. (vide Jowar).

## B. BORERS.

1. Stem borer—*Euzophera perticella* Rag. (*Pyralidae*). Minor pest. Caterpillars bore into the stem and may kill the plant. Generally attacks winter and summer crops. It is also recorded boring into tomato plants.
2. Fruit borer—*Leucinodes orbonalis* G. (*Pyralidae*). Major pest. Caterpillars pink, bore in the top shoots as well as the fruits which are rendered unremarkable. Winter crop is damaged severely. One generation may take 4-5 weeks.

## Sweet potato.

*Ipomoea batatas*. Grown throughout the year.

## A. LEAF FEEDERS.

## I. Biting :

1. Hawk moth—*Herse convolvuli* L. (*Sphingidae*). Minor pest. The caterpillar is stout and grey, provided with an anal horn. It feeds on the leaves and damages them. Commonly met with from July to October. One life-cycle occupies 10-12 weeks; pupation in the soil.

## B. BORERS.

1. Tuber weevil—*Cylas formicarius* Fb. (*Curculionidae*). Major pest. Both the adults and grubs tunnel into the tubers and cause their rotting. Occa-



sionally the vines may also be damaged which wither ultimately. The adults may also feed on the leaves.

#### Chilies.

*Capsicum*. Seedlings raised during June-July; transplanted July-August and harvested October-February.

#### A. LEAF FEEDERS.

##### I. Biting:

1. Lucerne caterpillar—*Laphygma exigua* Hb. Minor pest. (vide Jowar).

##### II. Sucking:

1. Thrips—*Thrips tabacci* L. (*Thripidae*). Major pest. Minute, pale insects feed on the underside of leaves and cause their curling. In severe cases the plants absolutely wither out.
2. Mites—Major pest. Damage similar to that of thrips.

#### Betelvine.

*Piper betel*. Perennial crop. Plucked when ready for harvest.

#### A. LEAF FEEDERS.

##### I. Sucking:

1. Leaf-bug—*Disphinctus maesarum* Kirk. (*Capsidae*). Major pest. Both the nymphs and the adults suck the sap from leaves as a result of which black spots appear. Active from June-December. Each generation may occupy 4-6 weeks.

#### OIL SEEDS

#### Groundnut.

*Arachis hypogea*. Sown in June-July; harvested during November-December.

#### A. ROOT FEEDERS.

1. White ants. (vide Sugarcane).

#### B. LEAF FEEDERS.

##### I. Biting:

1. Leaf roller—*Anartia ephippias* Meyr. (*Gelechiidae*). Minor pest. Caterpillars roll the leaves and feed inside.

##### II. Sucking:

1. Pod bug—*Aphanus sordidus* F. (*Lygaeidae*). Minor pest. Both the nymphs and adults suck the oil from the pods which give out rancid smell. One generation takes about 4-5 weeks. It is more a pest in the store than in the field.

#### Castor.

*Ricinus communis*. Sown in June or September; harvested in September and February.

#### A. LEAF FEEDERS.

##### I. Biting:

1. Castor semi-looper—*Archaea janata* (*Noctuidae*). Major pest. Black caterpillars feed on leaves and skeletonise them. Active from June-October. One generation occupies 4-5 weeks. Pupation in the soil.
2. Hairy caterpillar—*Pericallia vicini* F. (*Arctiidae*). Minor pest. Brown hairy caterpillars feed gregariously on leaves. Active from June-October. Pupation in the soil.
3. Castor butterfly—*Ergolis merione* Cr. (*Nymphalidae*). Minor pest. The caterpillars feed on leaves, and occasionally may defoliate the plants.
4. Woolly caterpillar—*Trabala vishnu* Lef. (*Lasiocampidae*). Minor pest. Small woolly caterpillars feed on leaves during the Kharif season only. It is generally a sporadic pest.
5. Slug caterpillar—*Parasa lepida* Cr. (*Limacodidae*). Minor pest. The young larvae are gregarious, later on they live solitary life. The white shell-like cocoons are found clustered on stems.

## II. Sucking :

1. Mealy wings—*Trialeurodes ricini* M. (Aleyrodidae). Minor pest. Nymphs feed on the underside of the leaves on which black mould develops. All the stages are found on the leaves during the growing period of the plants.
2. Leaf hopper—*Empoasca* sp. Minor pest. (vide Cotton).

## B. BORERS.

1. Shoot and capsule borer—*Dichocrocis punctiferalis* G. (Pyralidae). Occasionally a serious pest. Dark brown caterpillars bore and cut the tender shoots and also web the seeds. Pupation in silken cocoon in the shoot or capsule.

**Sesamum.**

*Sesamum indicum*. Sown from June, harvested from September.

## A. LEAF FEEDERS.

## I. Biting :

1. Leaf roller—*Antigastra catalaunalis* D. (Pyralidae). Minor pest. Small greenish caterpillars with dark tubercles; roll up and web the leaves and may also bore in the shoots and pods. Considerable damage may be caused in the seedling stage. Active from July-September.

## II. Sucking :

1. Pod bug—*Aphanus sordidus* F. (vide Groundnut).

## B. BORERS.

1. Gall-fly—*Asphondylia sesami* Felt. (Cecidomyiidae). Minor pest. The adults are like mosquitoes. The maggots bore into the flower buds or stem and produce gall-like structures.
2. Leaf caterpillar—*Acherontia styx* West. (Sphingidae). Minor pest. Stout and green caterpillars with anal horn, feed on leaves. There are two generations from July-December. Pupation in the soil.

## PULSES.

**Tur.**

*Cajanus indicus*. Sown from July and harvested from December.

## A. LEAF FEEDERS.

## I. Biting :

1. Aphis—*Aphis medicaginis* Koch. Minor pest. (vide Jowar).

## B. BORERS.

1. Pod borer—*Exelastes atomosa* W. (Pterophoridae). Major pest. The caterpillars are greenish brown, slightly hairy. They bore into the pods and feed on the seeds. Pupation on the pods. One generation occupies about 3-4 weeks.
2. Gram pod borer—*Heliothis obsoleta* F. Minor pest. (vide Gram).
3. Pod butterfly—*Catochrysops* (*Enchrysops*) *Cnejus* Fb. (Lycaenidae). Minor pest. Green slug-like caterpillars feed on pods and damage the contents.
4. Podfly—*Agromyza obtusa* M. (Agromyzidae). Major pest. The maggots bore into the seeds when they are green. Attacked pods present a shrivelled appearance. One generation occupies about 3 weeks.

## II. Sucking :

1. Podbug—*Riptortus linearis* F. (Coreidae). Minor pest. Dark brown bugs feed on the sap from the pods and cause their shrivelling. Active from September-March.

2. Podbug—*Clavigralla gibbosa* S. (Coreidae). Major pest. Small sized bugs, brown in colour. There are 4-5 generations from November-March and each cycle may occupy about 4 weeks.

**Gram.**

*Cicer arietinum*.

**A. LEAF FEEDERS.**

**I. Biting :**

1. Cut worm—*Agrotis ypsilon* Rott. Major pest. (vide Cruciferous vegetables).

**B. BORERS.**

Pod borer—*Heliothis obsoleta* F. Major pest. The young caterpillars feed on foliage and when grown up enter the Pods and destroy the seeds. Pupation in an earthen cocoon in the soil. There may be 4-6 generations in a year.

**Peas.**

*Pisum sativum*.

**A. LEAF FEEDERS.**

**I. Biting :**

1. Lucerene caterpillar—*Laphygma exigua* Hb. (vide Jowar).
2. Tobacco caterpillar—*Prodenia litura* F. (vide Tobacco).

**II. Sucking :**

1. Aphis—*Macrosiphum pisi* Kalt. Major pest. (vide Jowar).

**B. BORERS.**

1. Pod borer—*Heliothis obsoleta* F. Major pest. (vide Gram).

**Mung.**

*Phaseolus radiatus*.

**A. LEAF FEEDERS.**

1. Hawk moth—*Herse convolvuli* L. Minor pest. (vide Sweet potato).

**PEST OF FRUITS AND FRUIT TREES.**

**Mango.**

*Mangifera indica*.

**A. AFFECTING ROOTS.**

1. White ants—*Termites* sp. Major pest. (vide Sugarcane).

**B. LEAF FEEDERS.**

**I. Biting:**

1. Slug Caterpillars—*Parasa lepida* Cram. (Limacodidae). Minor pest. Caterpillars feed on leaves, mostly found on mango during December-March. Round shell-like cocoons are found in clusters on tree-trunks. The larval spines cause considerable itching if handled without covering the hands.

2. Leaf caterpillar—*Euthalia garuda* M. (Nymphalidae). Minor pest. Beautiful green caterpillars are observed feeding on the leaves. The pest may be found throughout the year.

3. Mango leaf webbing caterpillar—*Orthaga exvinasa* W. (Noctuidae). Minor pest. The caterpillars bind the leaves with silken threads and feed on green tissue. Often the damage is serious during August to March.

## II. Sucking :

1. Mango hopper—*Idiocerus atkinsoni* L., *Idiocerus niveosparvus* L. and *Idiocerus clypealis* L. (Jassidae). Major pests. Both the nymphs and adults feed on the sap of tender leaves and inflorescence as a result of which the flowers fall off without setting any fruits. 'Honey dew' secreted by the insects develops sooty mould and imparts blackish appearance to the plants. Breeding takes place twice during December-February and June and July. One generation occupies about 2-3 weeks.

2. Coccids. Major pest in three species. Both the nymphs and adults feed on sap. They cover the fruits and twigs in serious cases. Their presence attracts red ants.

## C. BORERS.

## I. Soot borers :

1. Mango shoot borer—*Chlumetia transversa* W. (Noctuidae). Major pest. The caterpillars bore into the growing shoots. Young grafted seedlings are severely damaged and may even be killed. Active from July—December.

2. Leaf and twig miner—*Acrocercops* sp. (Gracillariidae). Minor pest. The caterpillars attack very young leaves and fresh twigs. In case of seedlings some damage takes place. Active from November-April.

3. Castor capsule borer—*Dichocrocis punctiferalis* G. Minor pest. (vide Castor).

## II. Stem borers :

1. Mango stem borer—*Batocera rubus* L. (Cerambycidae). Major pest. The grubs bore into stems or branches as a result of which the plant may ultimately die. The pest is active throughout the year, one generation may take more than 12 months.

2. Branch borer—*Arbela tetraonis* M. (Arbelidae). Minor pest. The caterpillars occasionally bore into the branches and cause their death. It attacks various other trees besides mango.

## III. Fruit borers :

1. Fruit flies—*Chaetodacus ferrugineus* F. and *Chaetodacus zonatus* S. and varieties of *Chaetodacus ferrugineus*. Minor pests. The maggots bore into the ripening fruits and render them useless for consumption. Pupation takes place in the soil. There may be 2-3 generations during the mango season. They also attack many other fruits.

## D. GENERAL PESTS.

1. Red ants—*Oecophylla smaragdina* Fb. (Formicidae). They do not cause any direct damage to the plant but indirectly protect the coccids and white flies and cause their spread all over the plantation which results in considerable damage. They are also a nuisance at the time of harvest.

## Pomegranate.

*Punica granatum*.

## A. ROOT FEEDERS—NONE.

## B. LEAF FEEDERS.

## I. Biting:

1. Castor semilooper—*Archaea janata* L. (Noctuidae). Minor pest. The caterpillars are black which occasionally feed on leaves and defoliate the plants. Pupation takes place in the soil. The pest is active from June—December, during which period 3-4 generation are passed.

## II. Sucking :

1. Aphids. Minor pest. Both the adults and nymphs suck the sap especially from tender shoots and reduce the vitality of the plants. Active practically throughout.

2. Coccids. Minor pest. Both the nymphs and adults feed on leaves and tender shoots and in serious cases the plants may wither.

## C. BORERS.

1. Fruit borer—*Virachola isocrates* F. (*Lycaenidae*). Major pest. The caterpillars are black which bore into the fruits and render them inedible. The damage continues throughout the year and one generation occupies about 4–6 weeks.

## Citrus.

-*Citrus* sp.

## A. ROOT FEEDING.

1. White ants—*Termites* sp. Minor pest. (vide *Sugarcane*).

## B. LEAF FEEDING.

## I. Biting:

1. Lemon butterfly—*Papilio demoleus* L. (*Papilionidae*). Minor pest. The caterpillars are green in colour and feed on leaves. In nurseries the seedlings may be absolutely defoliated. The pupae stick to the leaves, and the adults are noticed throughout the year.

2. Leaf miner—*Phyllocnistis citrella* S. (*Lyonetiidae*). Minor pest. The caterpillars mine the leaves and feed in between two epidermal layers. The damage continues throughout the year.

## II. Sucking :

1. Coccids—*Chrysomphalus aonidum* Riley, and *Pseudococcus citri* R. Major pests. Both leaves and fruits are attacked. The infested fruits lose attraction. The second species may also attract the red ants.

2. White flies—*Dialeurodes citri* A. (*Aleyrodidae*). Major pest. Black nymphs are seen feeding on the underside of leaves. 'Honey dew' secreted by the pest develops sooty mould which interferes with the photosynthesis. Active from October–February.

3. Aphis—*Toxoptera aurantii* Boy. Major pest. Both the adults and nymphs feed on the sap of growing shoots and in severe cases the growth of the plant is considerably checked. Active practically throughout the year.

## C. FRUIT SUCKING.

1. Fruit sucking moths—*Ophideres fullonica* L. and *Ophideres materna* L. (*Noctuidae*). Major pest. The caterpillars feed on some wild plants. The adults are the real pests since they puncture the fruits and feed on the juice. The fruits thus damaged begin to rot and drop down. Active from July to October.

## D. BORERS.

1. Fruit fly—*Chaetodacus ferrugineus* F. and varieties. Minor pest. (vide *Mango*).

2. Red ants—*Oecophylla smaragdina* F. Major pest. (vide *Mango*).

## Guava.

*Psidium guava*.

## A. LEAF SUCKING.

1. Mealy bugs—*Pulvinaria psidii* M. (*Coccidae*). Major pest. The nymphs and adults feed on leaf sap. Sooty mould is developed on the 'Honey dew' secreted by them and the entire plant becomes black and sticky.

## B. BORERS.

1. Stem borer—*Arbela tetraonis* Mo. Minor pest. (vide *Mango*).

2. Castor capsule borer—*Dichocrosis punctiferalis* G. (*Pyrilidae*). Minor pest. (vide *Castor*).

## Grapevine.

*Vitis vinefera*.

## A. LEAF FEEDERS.

## I. Biting:

1. Leaf beetle—*Scelodonta strigicollis* Mots. (*Chrysomelidae*). Major pest. The adults feed on growing shoots and leaves. They resemble 'Udid' grain and therefore known as *Udadya beetles*. The immature stages are passed in the soil and the damage after October pruning is most serious.
2. Cockchafer beetle—*Adoretus ovalis* Bl. Minor pest. (vide *Sugarcane*).

## II. Sucking :

1. Thrips—*Rhipiphorothrips cruentatus* H. (*Thripidae*). Minor pest. The nymphs and adults feed on leaf sap and in severe infestation the shoots may wither away.

## Plantain.

*Musa sapientum*.

## A. LEAF FEEDERS.

1. Tobacco caterpillar—*Prodenia litura* F. Minor pest. (vide *Tobacco*).
2. Hairy caterpillar—*Pericallia ricini* F. (*Arctiidae*). Minor pest. Brown hairy caterpillars feed gregariously on the leaves. Only one generation attacks the plantation during July and August.

## B. BORERS.

1. Stem and root borer—*Cosmopolites sordidus* G. (*Curculionidae*). Minor pest. Dirty white, legless grubs bore into the roots and stem. The adults are black with a conspicuous snout. Breeding takes place throughout the year.

## Coco nut palm.

*Cocos nucifera*.

## A. LEAF FEEDERS.

## I. Biting:

1. Black headed caterpillar—*Nephantis serinopa* M. (*Xyloryctidae*). Major pest. The caterpillars prepare galleries of their own excreta and lead hidden life on the underside of leaves. The damaged leaf appears as if scorched. One generation occupies about 5-6 weeks. Active during the monsoons.

## B. BORERS.

## I. Soot borers :

1. Palm beetle—*Oryctes rhinoceros* L. (*Dynastidae*). Major pest. Adults are black beetles with a horn-like projection on the head, shining above and hairy below. They bore into the growing shoots and kill the fronds. The immature stages are met with in the manure pits. Only one generation in a year.
1. Palm weevil—*Rhynchophorus ferrugineus* F. (*Curculionidae*). Major pest. The adult is reddish-brown weevil. The grub bores into the growing shoots and damages them seriously.

## FRESHWATER ALGAE NEAR BOMBAY.

### 1. The Seasonal Succession of the Algae in a Tank at Bandra.

BY

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*(With 5 graphs and 8 plates)*

#### INTRODUCTION.

The immensity of the field of algal ecology and the diversity of its problems have been recognized by most algologists, who also emphasize the value of one aspect of the subject, *viz.* prolonged periodical observation of the algal flora of any piece of water. This is very necessary, since algal species are known to appear and disappear with startling rapidity.

Fritsch (1906, 1907) was the first to indicate the lines along which research in algal ecology would be useful. Later, with Rich, in a series of papers (1907, 1909, 1913), they pointed out that small bodies of water such as pools and ponds are very suitable for demonstrating the relations between external conditions and algal growth, as they readily react to changes in the meteorological and other conditions.

Among other contributors to the subject were Transeau (1913, 1916) who made continuous records, extending over a number of years, of algal conditions in Central Illinois and Griffiths (1916, 1922, 1923, 1925-27, 1927), who made an attempt to elucidate the factors determining the composition of the water solution of pools in different parts of England, and consequently the occurrence of the plankton. Similar studies were made by Hodgetts (1921, 1922), Atkins and Harris (1924, 1925), Howland (1931), Lind (1938) and others.

Though Iyengar (1928, 1938), Biswas (1932) and Ghose (1933) have all stressed the need for such work, the only contributions from India so far have come from Pruthi (1933), who worked on the seasonal succession of the algal flora of an artificial tank in Calcutta, and correlated the occurrence of the different species with the physical and chemical condition of the water, Ganapati (1940, 1941, 1943), who worked on the same lines in Madras, and a few others.

In India however, owing to the diverse climatic conditions, the inferences drawn at one place will not be applicable to another. It





Photo 1. Monsoon aspect of Bandra Tank.



Photo 2. Dry Season aspect of Bandra Tank.

BOMBAY ALGAE



was therefore decided to study the algae of the ponds around Bombay systematically for at least a year, and to correlate the quantity and nature of the algae present in the different seasons with the chemical and physical features of the water and the prevailing meteorological conditions.

#### DESCRIPTION OF THE TANK.

The first piece of water selected for study was a tank situated at Bandra to the north of Bombay. It is known as the Motha Tank (*Bombay Gazette*, 1882) and is close to the railway station. It is approximately six acres in area and roughly quadrilateral in shape (Fig. 1). On its western and eastern

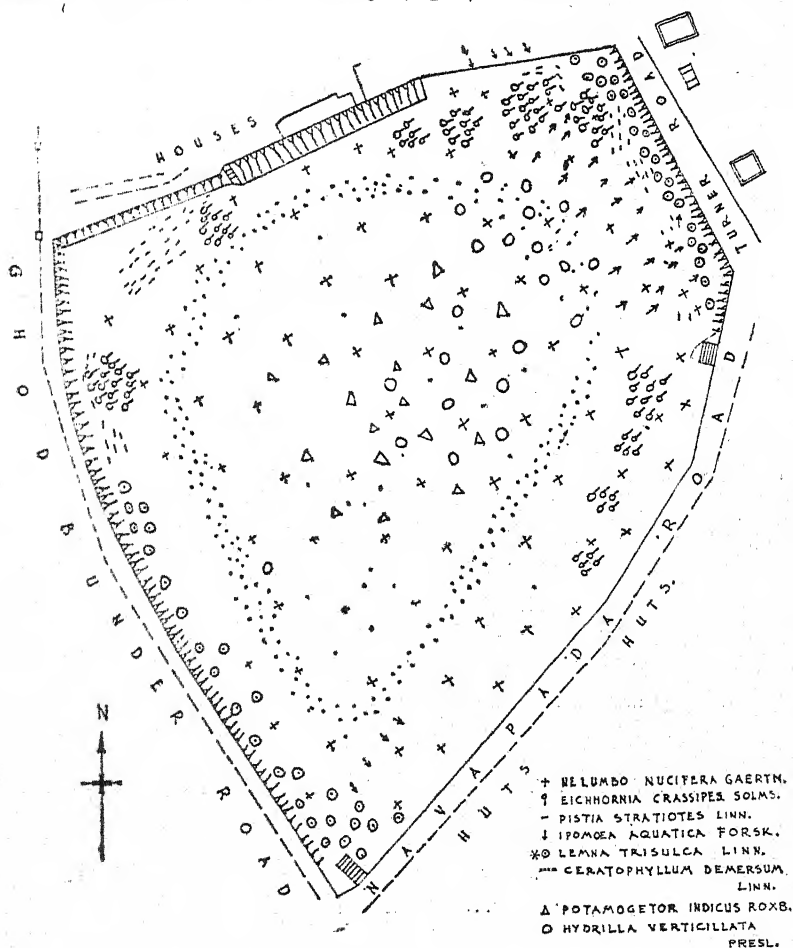


Fig. 1.—Plan of the Tank at Bandra.

sides, it is bounded by public roads. To the south is a by-lane, on the other side of which are a number of huts, whose occupants make free use of the

\* The identity of the species of *Lemna* is uncertain.

water of the tank for washing and other purposes. On the northern side is a wall, flanking which are a number of buildings.

The tank is exposed to the full force of the sun and the wind, and hence is more easily affected by variations in meteorological conditions. Its main supply of water is from rain received during the monsoon. During the latter half of the monsoon, it overflows through an outlet into a low level street drain. The average depth of the tank is 12 feet, the maximum level in the monsoon being 15 feet. The depth towards the end of May in the middle is 6 feet.

A study of this tank is of additional interest, as it is used by the Department of Fisheries, Bombay, for stocking and breeding freshwater fish. Pearsall (1924) has laid considerable emphasis on the economic importance of limnological studies, on account of their relation to problems connected with freshwater fisheries.

#### PHANEROGAMIC VEGETATION OF THE TANK.

In this tank there is a profusion of water weeds. The chief form is *Nelumbo nucifera* Gaertn. (*Nelumbium Speciosum* Willd.) which covers practically the whole surface and is not restricted to any definite region (Photograph 1). Except for *Nelumbo*, the plants are not found scattered indiscriminately all over the tank, but there is some sort of zonation. The first zone consists of *Lemna*, *Eichhornia crassipes* Solms., *Pistia Stratiotes* Linn. and *Ipomoea aquatica* Fosc. The second zone consists of *Ceratophyllum demersum* Linn., together with which on the eastern side may be mixed *Hydrilla verticillata* Presl. The centre of the tank is occupied chiefly by *Potamogeton indicus* Roxb., and a small amount of *Ceratophyllum* and *Hydrilla*. In addition the following plants have occasionally been found, viz. *Limnanthemum indicum* Thw., *L. cristatum* sp. Griseb., *Najas*, *Wolffia Michelii* Sch.

When the pond dries up in summer (Photograph 2) numerous grasses spring up and shepherds utilize the dry portion as a grazing ground for their flocks.

#### METHODS.

Collections of the algae were made once a fortnight from along the sides of the tank and from the middle. The frequencies of the various species were noted according to the method of Howland (1931) (cf. also Gonzalves and Joshi, 1943). The quantity of the larger algae was estimated from general impression obtained after observation made in the open field. The diatoms were not taken into account in the investigation.

#### METEOROLOGICAL DATA.

The meteorological data viz. for temperature, sunshine value and rainfall were obtained from the Bombay Observatory. The monthly average temperature was calculated from the maximum and minimum temperatures each day. The monthly average sunshine value was calculated from the values of daily hours of bright sunshine. The rainfall for the month represents the total rainfall received during the month. The meteorological data from December 1940 to November 1941, during which time the tank was under observation, are given in Appendix I. The rainfall for the year was only 34.19 inches, very near the minimum (33.4 inches) recorded during the last 90 years. Consequently in most of the months the maximum temperature exceeded the average. The graphs showing the average temperature, rainfall and hours of bright sunshine are shown in Fig. 2.

#### CHEMICAL ANALYSIS OF THE WATER.

Every month the water was chemically analysed. In order to calculate the results statistically, eight samples of water from different parts of the tank were each month analysed for (1) dissolved oxygen, (2) free carbon dioxide, (3) total dissolved solids, (4) total hardness, (5) oxidisable organic matter, (6) free ammonia, (7) albuminoid ammonia, (8) nitrites, (9) nitrates, (10) carbonates, (11) bicarbonates, (12) chlorides, (13) phosphates and (14) pH. The results are given in Appendix I and were in all cases found to be statistically significant. The samples were collected as far as possible every time between 11 a.m. and 12 noon.

*Dissolved Oxygen.*

The dissolved oxygen was estimated by Winkler's method (Public Health Chemical Analysis, pg. 96).

The oxygen content of any piece of water as mentioned by Ganapati (1940) depends on the composite effect of the following factors:—(1) the solubility of oxygen depending upon the temperature at the time of sample collection, (2) the intensity of illumination, (3) photosynthetic activity of the vegetation, (4) respiratory processes, (5) wind action and (6) abundance of vegetation. Con-

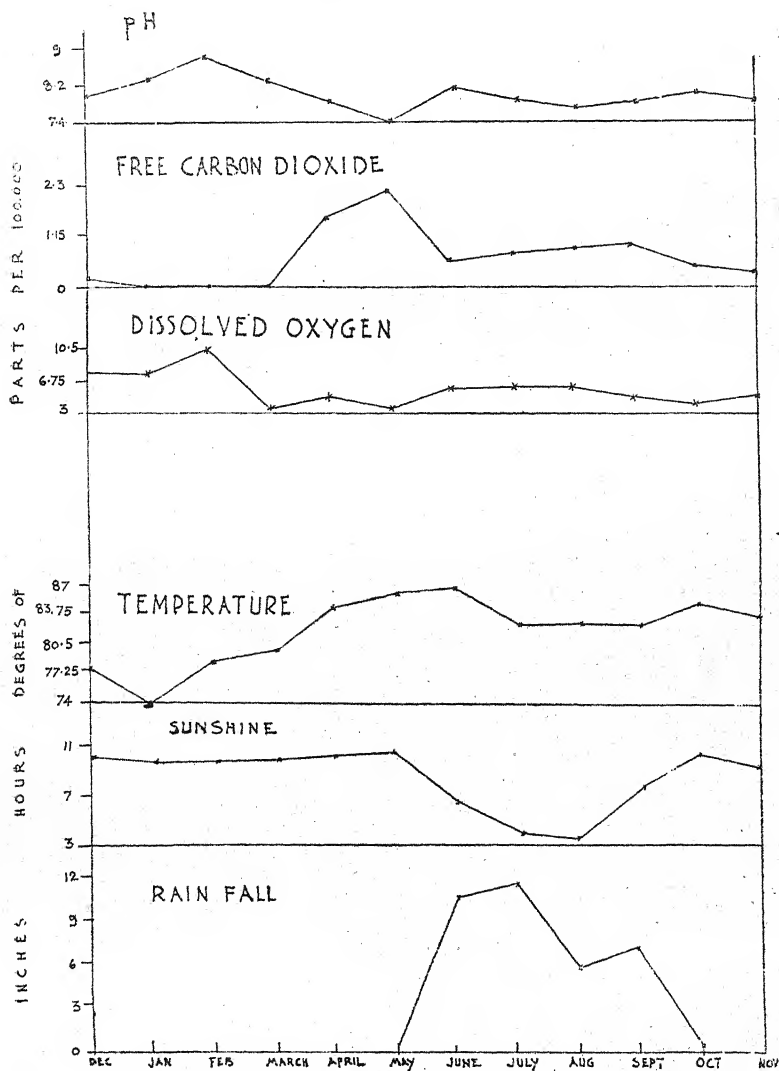


Fig. 2.—Graphs showing meteorological data and variations in the pH, free  $\text{CO}_2$  and Dissolved Oxygen of the water of the Tank.

sidering the first factor, it can be seen from the results that periods of high temperature were, except in a few cases, periods of low oxygen content (Fig. 2).

The intensity of illumination had a limited effect on the dissolved oxygen content. During the months of December, January and February, when the sunshine values were high, the amount of dissolved oxygen was also high; but in May and October, though the hours of bright sunshine were very high, there was a fall in the oxygen content, due to causes which will be discussed later.

The algae and phanerogams, both qualitatively and quantitatively were found in very healthy condition in January, February and March. Except for March, the amount of dissolved oxygen in these months was unusually high. This is natural because the greater the amount of vegetation, the greater the assimilation and the consequent liberation of oxygen. The fall in the oxygen content in the month of March may probably be due to the removal of some of the aquatic plants from the tank. About this time the fish were also in abundance. According to Pearsall (1924), an increase in the amount of fish is normally correlated with an increase in the abundance of plankton organisms and is also dependent on the physico-chemical condition of the water. The fish utilize the oxygen of the pond in respiration, but the abundant vegetation during photosynthesis returns much more oxygen to the water.

In the rains active assimilation cannot take place due to cloudy weather and hence the respiratory activities are more marked. A fall in the oxygen content is therefore natural. This however, was not observed. In all probability there was less demand on the oxygen, since the amount of vegetation was less during the monsoon and the number of fish was also few, a large number of them having been removed from the tank at the end of May. Another factor, however, played a more important part at this time. Due to the action of wind, the water was oxygenated by mechanical admixture of air and water particles.

The fall in oxygen content in May was due to the temperature and to the unhealthy condition of the vegetation. At the end of the hot season, there was greater consumption of oxygen to oxidise the disintegrating plants. The dissolved oxygen in the water of this tank is thus influenced by a number of factors, the two most important being temperature and the aquatic vegetation.

## 2. Free Carbon Dioxide.

Free carbon dioxide was estimated volumetrically using phenolphthalein as indicator according to the method given by Thresh, Beale and Suckling (1933), p. 307.

The free carbon dioxide in any water varies somewhat rapidly. In this tank it was completely depleted in January, February and March. After March, owing to the photosynthetic activity of the vegetation, it increased and the maximum was reached in May, due to decay of organic matter. A steady fall followed with only a slight rise in August and September (cf. Appendix I).

There was a slight degree of relationship between the sunshine values and the free carbon dioxide. The free carbon dioxide did not always vary inversely with the oxygen content. A definite relation to the pH and bicarbonates was noticeable. Except for July and November, the free carbon dioxide content was always inversely proportional to the pH (Fig. 2). Howland (1931) and Pearsall (1930) also observed the same relationship.

## 3. Total Solids.

They were estimated according to the method given in Public Health Chemical Analysis, p. 68.

The amount of total solids was low in the cold season, high in the hot season and decreased in the monsoon. The slight fall in February might have been due to the rain received in the preceding month, as also to greater absorption due to increase in numbers and development of the algae and phanerogams. In May, most of the vegetation was decaying and so a rise in the amount of dissolved solids was natural, as the products of decaying matter were returned to the water. The total solids varied in proportion to the temperature (Figs. 2, 3), and nearly always varied inversely to the water level. In June however, there was no immediate fall in the amount of dissolved solids, even though the rainfall was 10.33 inches. Transeau (1916) has shown that high salt concentration does not always coincide with low water level, as the rains bring

in soluble salts as well as silt, clay and suspensoids which settle slowly at the bottom of the pond. Hodgetts (1921) also found that the water level and the amount of dissolved salts were not always inversely proportionate.

There was a clear relation between the pH and solids in the first half of the year. When the former was high, the latter was low and vice versa; but in the latter half of the year, the relationship was not so apparent.

#### 4. Total Hardness.

Estimations were made according to the soap method (Public Health Chemical Analysis, p. 84). Results are given in degrees of hardness.

According to Thresh, Beale and Suckling (1933, p. 21) the water can be classified as fairly hard. In the cold weather, the values for hardness were fairly low (Fig. 3) due to precipitation of the carbonates by the abundant water plants. A rapid increase occurred in the hot season due to increase in the amount of bicarbonates. Low figures were obtained during the monsoon probably as a result of the rainfall and the consequent dilution of the water. The hardness varied inversely with the water level except on one occasion, viz. in February.

#### 5. Oxidisable Organic Matter.

Tidy's modification of the Forschammer's process was used in the estimation of organic matter (Public Health Chemical Analysis, p. 93).

The amount of organic matter was moderately low in the beginning of the year; but with the onset of the hot weather and the consequent decay of vegetation, the values increased till the maximum was reached in May. The beginning of the monsoon caused a lowering of the values, till the minimum was reached in August. The amount of oxidisable organic matter rose towards the end of the year (cf. Appendix I and Fig. 3).

#### 6. Free Ammonia.

It was estimated by Wanklyn's Process (Public Health Chemical Analysis, p. 77).

In the beginning of the cold season, there was a fall in the amount of free ammonia, till the minimum was reached at the end of the season. A rise in April was followed by a fall in May. During the rains, the values for free ammonia were very high, the maximum being reached in August. This was probably due to washings from the surrounding areas being brought into the water by the rains. After August there was a gradual fall till November (cf. Appendix I and Fig. 3).

#### 7. Albuminoid Ammonia.

It was estimated by Wanklyn's process (cf. above).

After December there was a fall in albuminoid ammonia, till the minimum was reached in February and March. Then it increased till a fairly large amount was present in May and June, when masses of vegetation were in the process of decay. During the monsoon, there was a decrease in albuminoid ammonia till August, followed by an increase in the remaining months of the year. On the whole except for February and March, there seemed to be some correlation between albuminoid ammonia and organic matter.

#### 8. Nitrites.

They were estimated by Ilsoy's Naphthylamine Test (*Journal of the Marine Biological Association*, Vol. 14, p. 56).

Nitrites were only found in traces throughout the year.

#### 9. Nitrates.

They were estimated by Frederick's modification of the Phenolsulphonic sulphuric acid method (Public Health Chemical Analysis, p. 81).

From December the nitrates decreased gradually till the minimum was reached in February. Then they rose with the rains, till the maximum was reached in July, after which there was a fall.

When vegetative activity was high, nitrates were depleted by the phanogams and green algae. At the end of the hot season, the nitrates were fairly



high, due to the decaying vegetation. They increased still more during the monsoon, probably due to drainage water charged with nitrates from the surrounding land being washed into the tank by the rains, and to the disturbed condition of the water (Fig. 3). Lind (1938) also found an increase in nitrates after heavy rainfall.

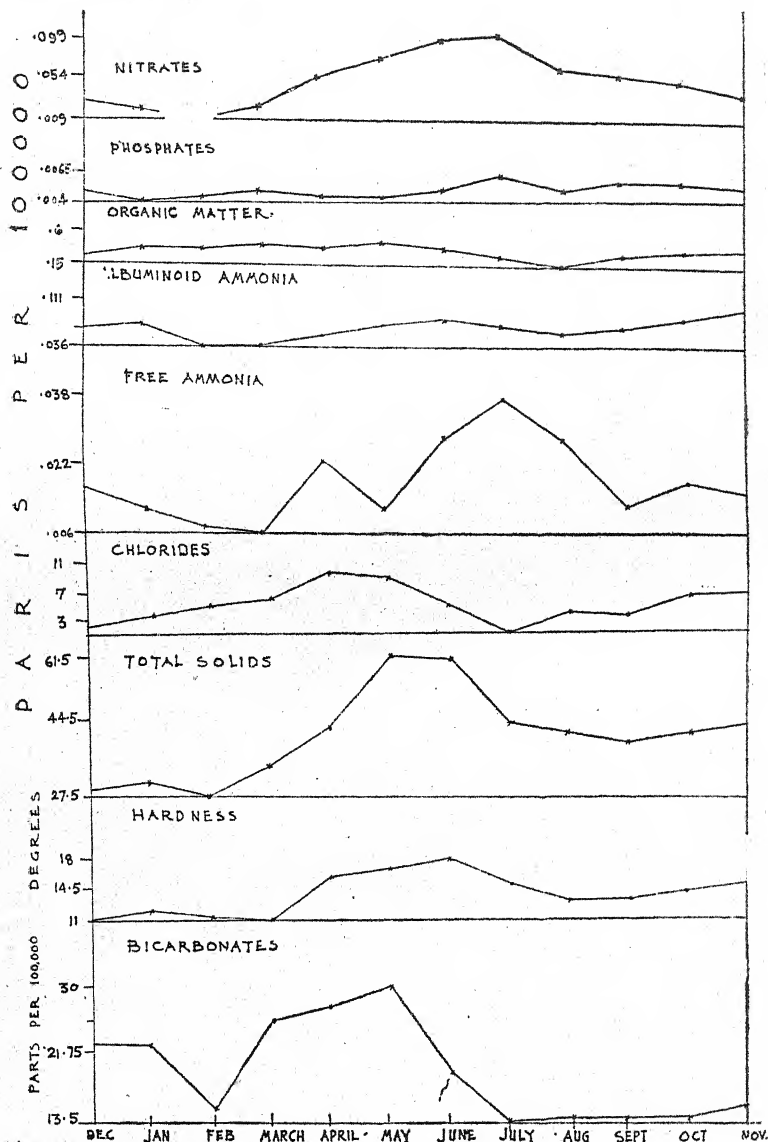


Fig. 3.—Graphs showing variations in the chemical constituents of the water of the tank.

10. *Carbonates.*

They were estimated by the acid-alkalinity method. (Sutton, p. 65).

They were found only for three months when carbon dioxide was absent. According to Ganapati (1941) the period of active photosynthesis is a period of greater formation than destruction of organic matter. In the absence of free carbon dioxide, the green plants utilise the carbon dioxide from the bicarbonates for assimilatory purposes and the result is the precipitation of the less soluble carbonates.

11. *Bicarbonates.*

They were estimated by the acid-alkalinity method. (cf. above).

The bicarbonates were variable in the cold season. The low values in February were probably due to the causes enumerated above. The rise in March may have been due to the removal of some of the green plants and the consequent lowering of the rate of photosynthesis. The large amount of decaying vegetation accounts for the rise at the end of the hot season. After the hot season, there was a steady decrease in the bicarbonates, which remained fairly low and almost constant during the monsoon.

12. *Chlorides.*

They were estimated by the standard  $\text{AgNO}_3$  method using potassium chromate as an indicator (Public Health Chemical Analysis, p. 70).

The values for chlorides seemed to depend on the water level. When the water level was decreasing and the concentration consequently increasing, the chlorides also increased. In April and May, the amount of chlorides was therefore high, while the water level was very low (Fig. 3). With the rise in water level due to the rains and the consequent dilution of the water, the amount of chlorides diminished.

13. *Phosphates.*

They were estimated colorimetrically by the method given by Atkins (1923) (cf. the Coeruleomolybdic Method of Deniges, *Journal of the Marine Biological Association*, Vol. 13, p. 144).

The values for phosphates were fairly low and more or less constant. Their production was continuous throughout the year by bacterial action, as also by contamination of the tank by human agencies. They are among the important nutrient substances found in pieces of water. The slight fall in phosphates in the cold season was due to utilization by the green vegetation during photosynthesis. Atkins (1923) found that the values for phosphates in ponds were considerably less in the months in which photosynthesis is active. In this tank the fall in phosphates was not so apparent.

14. *pH.*

The pH was determined in the field roughly with Universal Indicator. In the laboratory the pH was again determined using Beckmann's pH meter with the glass electrode.

The pH value was highest in the cold season due principally to the richness of the flora. In the hot season the minimum was reached as a result of stagnation, decay of vegetation and an increase in carbon dioxide. Atkins and Harris (1924) and Pearsall (1930) also observed a seasonal rise and fall in pH. The pH value showed a considerable degree of correlation with temperature, the concentration of dissolved carbonates and bicarbonates, concentration of the nutrient salts, dissolved oxygen, and as mentioned before, with the free carbon dioxide. On several occasions this was clearly brought out, e.g. in February the values for pH, oxygen and carbonates were very high, while the bicarbonates were low and free carbon dioxide absent (Figs. 2 and 3).

A general consideration of the chemical nature of the water showed that all the salts increased with a decrease in the water level. At the close of the hot season, the water level was extremely low, and due to the stagnant conditions, unoxidised organic compounds were present, resulting in high oxygen absorption and an increase in ammonia and carbon dioxide values. The dissolved solids, organic matter, chlorides and bicarbonates also reached their maxima. With the first rains, these decreased slightly and the values for hardness and albuminoid ammonia were very high, but there was not much change in the amount of dissolved solids. As the rainfall increased, there was a

TABLE I

THE FREQUENCIES OF SOME OF THE ALGAL SPECIES IN THE BANDRA TANK

	Dec.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.
*1. <i>Pandorina morum</i> .	...	...	...	...	...	...	va	a	rc	...	...	...
*2. <i>Gloecolacium</i>	vc	va	c	rc	c	rc	r	...	r	r	c	vc
*3. <i>Loitlesbergerianum</i>	rc	rc	c	vc	a	c	rc	rc	vc	rc	rc	rc
*4. <i>Oetogonium decipiens</i> f. <i>dissimile</i> .	rc	rc	c	vc	a	c	rc	rc	rc	rc	rc	rc
*5. <i>Spirogyra formosa</i> .	rc	rc	c	vc	a	rc	r	vc	c	rc	rc	c
*6. <i>Cosmarium Quadrum</i>	i	rc	rc	c	va	rc	i	i	i	i	i	i
*7. <i>Coelosphaerium</i>	r	rc	rc	vc	c	a	c	rc	rc	rc	r	r
*8. <i>Aphanocapsa Elastica</i> var. <i>conferta</i>	i	rc	rc	a	a	a	rc	...	rc	rc	rc	rc
*9. <i>Lyngbya Birgei</i>	r	r	rc	va	a	a	a	c	rc	rc	r	r
*10. <i>„ sestuariai</i> .	i	r	rc	a	rc	rc	c	a	rc	c	c	i
*11. <i>Anabaena fertilis</i> - <i>sima</i>	r	va	r	...	...	r	r	r	...	...	...	...
*12. <i>Aulosira fertilis</i> - <i>sima</i>	c	...	...	...	...	...	...	...	rc	c	va	a

\* Represents 'dominant' species.

† Represents sectual reproduction.

The numerical values of the symbols are obtained from counts of individuals found in 50 fields of the microscope, under a magnification of 350 and the meanings are as follows :—

i (isolated) = 1; vr (very rare) = 1-5; r (rare) = 5-10; rc (rather common) = 10-20; c (common) = 20-30; vc (very common) = 50-100; a (abundant) = 100-200 and va (very abundant) 200-400.

consequent decrease in all salts, till a minimum was reached in the middle of the monsoon. As the monsoon abated, a rise in the dissolved solids followed.

The amount of total solids in December 1940 was much lower than the amount of solids in November 1941. This was probably due to the wide difference in the amounts of rainfall during the two years. The year 1941 was exceptional, the rainfall being very low, viz. 34.19 inches, whereas in 1940 the rainfall far exceeded the average, amounting to 90 inches.

#### THE ALGAL FLORA OF THE TANK.

The number of species observed throughout the year was 103. Table I shows the frequencies of some of the more common forms. Some of the species are seen throughout the year and can be regarded as *perennials* even though they may not be in abundance at any time. These, according to Pearsall (1924) are the *constant* forms as they are found in all or in over 75% of the collections. A large majority of the remaining forms are seen for a brief spell, either as stray or common forms. Such species are regarded as *ephemerals*. A third group of algae are seen for a longer period than the ephemerals but not throughout the year. For the purpose of discrimination they are called the *intermediate* species. If any of the species in these groups at any time constitutes 30% of the algal vegetation, it can be called the *dominant* species of the period. The list of the algae is given in Appendix II. The letters after the name of the alga denote whether it is constant (c), intermediate (i) or ephemeral (e).

#### SUCCESSION OF THE ALGAL FLORA.

The algae are very plastic forms and can adapt themselves to numerous alterations in their environment. Changes in the weather and water conditions however, do affect them to a certain extent, so that some forms are only seen when conditions are favourable to their growth. In this tank a definite succession of the algal flora was observed from season to season.

#### THE ALGAE OF THE COLD SEASON.

The investigation commenced in December at the beginning of the cold season. This season (Dec-mid-March) is characterised by low temperature, fairly long hours of bright sunshine and little or no rain. The daily range of temperature is largest during this time and may be over 11°.

In December all the algal classes were represented by a few forms belonging to each, except the *Heterokontae*, which occurred later. As the season advanced, numerous species appeared, the majority in small numbers; but a good percentage thrived satisfactorily, increased in quantity and then declined. Many of them were restricted to the cold season only. Some of them became abundant in the early part or the middle of the cold season. Others took longer to develop, and reached their maxima towards the end of the cold season.

The majority of the green filamentous forms such as *Zygnema*, *Spirogyra*, *Bulbochaete* and *Oedogonium* thrived best at this time and reproduced themselves, some at the commencement, others at the end of the season. The period was also most favourable for the growth of members of the *Desmidiaceae* and *Chlorococcales*. Of the *Myxophyceae*, only *Anabaena fertilissima* was found in abundance in the early part of January.

#### THE ALGAE OF THE HOT SEASON.

The hot season (mid-March-May) is characterised by long hours of bright sunshine, high temperature and no rainfall. The day to day variation in temperature is smallest during this season, particularly in April and May, when the temperature is very high and the humidity is high. *Oedogonium* continued forming oospores and remained fairly well represented during the early part of the hot season.

A gradual change occurred in the algal flora from the middle of March onwards. Most of the desmids disappeared and only a few persisted as stray specimens. Except for *Scenedesmus*, which was seen in May, the green algae were in the minority in the latter half of the hot season while members of

the *Myxophyceae* were prominent. Numerous *Euglenineae* also appeared in small numbers. Towards the close of the hot season, the rest of the vegetation was in an unhealthy condition and masses of them commenced to decay. Except for a small portion in the middle, the tank was dry (Photograph 2). Some of the fish were removed at this time, as the unhealthy conditions affected them adversely.

Thus the only forms that flourished during this period were members of the *Euglenineae* and the *Myxophyceae*. The dominant form of the first half of the season was *Oedogonium* and of the latter part of the season were *Lyngbya Birgei* and *Coelosphaerium Kuetzingianum*.

#### THE ALGAE OF THE MONSOON.

The rains in Bombay occur from June to September. The monsoon as a rule is usually accompanied by squally winds and afternoon thunderstorms. Once it has well set in, thunderstorms are rare; but they may occur again towards the end of the season. The arrival of the monsoon causes a welcome fall of temperature and sunshine values also drop. In 1941 the monsoon behaved very erratically, and the total rainfall was only 34.19 inches, well below normal. The temperature also was above the average.

During the period of heavy rain, the tank seemed more or less devoid of algae; but as soon as there was a spell of bright sunshine in the latter half of June, there was a sudden swarming of *Pandorina morum* in the tank, causing a bloom to the exclusion of almost all the other algae. This was the outstanding feature of the monsoon period. Another noteworthy event was the occurrence of a second sexual phase in two species of *Oedogonium*. The least number of algal species occurred during the wet season. This was to be expected as the unsettled and disturbed condition of the water, due to the action of rain and wind, naturally retarded algal development. The algae are delicately constituted, and sudden changes in the concentration of dissolved matter will affect them immediately. Moreover as it was very cloudy, the sunshine necessary for photosynthesis and growth was not available. The dominant form in the early half of the monsoon was *Pandorina morum*, in the latter half, the two species of *Oedogonium*.

#### THE ALGAL FLORA IN OCTOBER AND NOVEMBER.

After the withdrawal of the monsoon, there is again a rise in the mean temperature in the first half of October, which remains constant till November. This is again another period of minimum variability of temperature, the meteorological conditions at this time being the same as in May. In 1941 there was no rain at all in October and November.

As the hours of bright sunshine increased, new species made their appearance, particularly in November, but the increase in number was gradual. Two members of the *Chlorococcales* viz. *Selenastrum gracile* and *Gloeotaenium Loitlesbergerianum* and a few members of the *Myxophyceae* such as *Anabaena Fullebornii* and *Aulosira fertilissima* etc. were characteristic of the period. The presence of a number of forms belonging to the *Myxophyceae* was not unexpected, as the meteorological conditions in October and May are almost similar, and therefore certain resemblances in the algal flora during the two months, are likely.

#### DETAILED CONSIDERATION OF SOME OF THE SPECIES.

It is a well-known fact that maintenance of chemical and physical conditions is necessary to allow normal algal growth. It is, however, rather difficult to single out a factor or a group of factors and to attribute to them the presence or absence of a particular species, and therefore no general deductions will be made in this section, but only the local conditions of weather and water favourable for the growth of the more important genera will be discussed.

## ISOKONTAE (CHLOROPHYCEAE).

## VOLVOCALES.

*Gloeocystis*.—It was seen in December, became abundant in April and disappeared entirely (Fig. 4) with the first rains. The chief factors influencing its

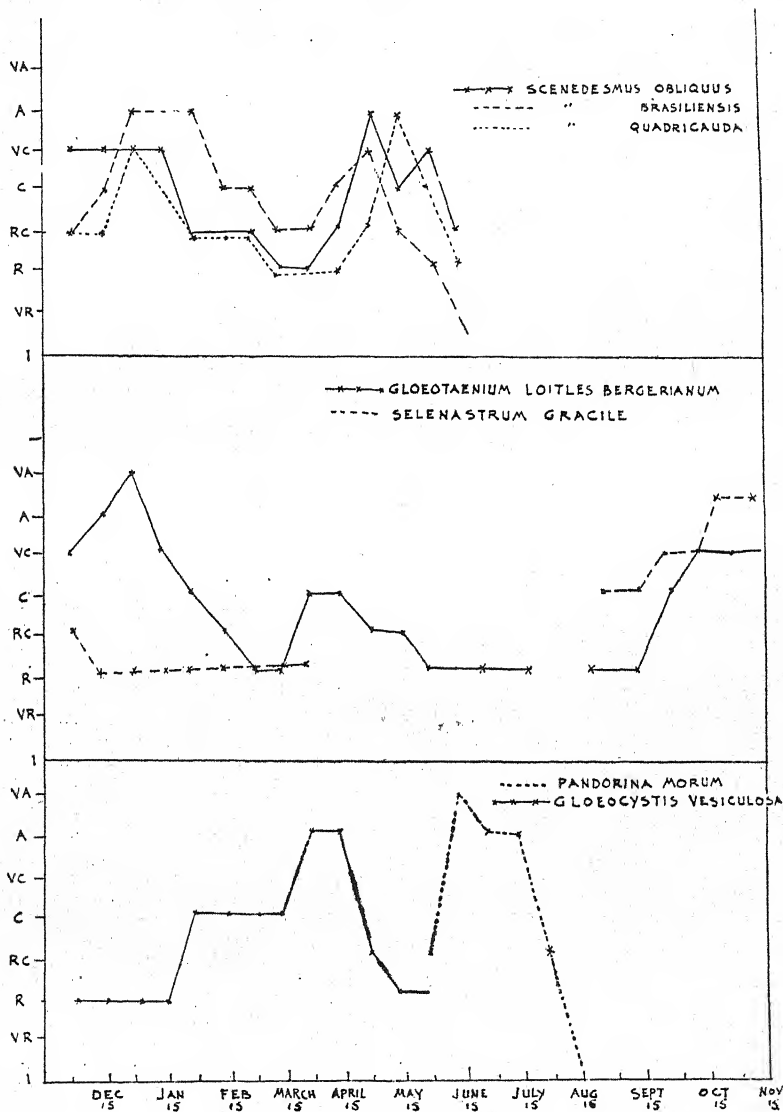


Fig. 4.—Frequency-graphs of some of the algae in the Bandra Tank

increase in numbers, seemed to be the meteorological conditions, as it was found when the temperature was fairly high, the hours of sunshine very

high and when there was no rain. It disappeared when the temperature and the sunshine values were lowered, and when the rainfall was plentiful.

**Pandorina**—It appeared with startling suddenness in the monsoon after the first few showers, and developed so rapidly (cf. Fig. 4), that within less than a fortnight the tank was teeming with it, and the water took on a greenish hue. Asexual reproduction occurred almost immediately after maximum development.

The causes underlying such sudden swarming of plankton are difficult to determine, but Akehurst (1931) found that swarming may be due to the availability of accessory foods. Other workers have found that the Volvocales are erratic in occurrence, and are markedly influenced by sudden changes in the weather. According to Howland (1931) *Pandorina morum* was very common in a month when the rainfall was abnormally high, sunshine record low, and the salt concentration not unusually high; while Fritsch and Rich (1913) found that abundant sunshine and high salt concentration were detrimental to its growth. Hodgetts (1922) however found pronounced growth of *Pandorina* coinciding with rising concentration. Here *Pandorina* occurred after sudden and much rain and when there was less of sunshine and decreasing concentration.

### CHLOROCOCCALES

**Gloetiaenium**—Except for the month of July, when the rainfall was very high, this genus was seen throughout the year, though not in abundance. It commenced to increase from October and in January it reached its maximum after which there was a fall in its numbers (Fig. 4). The conditions favourable for its development were very low temperature, fairly long hours of sunshine, low concentration of dissolved solids, large amount of dissolved oxygen and not much carbon dioxide and nitrates.

**Scenedesmus**—All the three species of *Scenedesmus*, though not equally abundant, had two maxima. The first was in the cold season (Dec.-Jan.). A sudden increase occurred in May, followed by rapid disappearance (Fig. 4). The periodicity of *Scenedesmus* was rather puzzling, as the physical and chemical conditions of the water on the two occasions when it was in abundance, were totally different. The only similar factors were absence of rain, long hours of sunshine and the same amount of free and saline ammonia. On the whole it is dangerous to attribute the presence or absence of *Scenedesmus* to any particular factor, as it seems to be one of those ubiquitous forms which is rarely absent from any piece of water, and is seen almost throughout the year.

**Selenastrum**—It was found in December 1940 as a rather common form, but presumably it was declining, as in January 1941 it was rare. It disappeared in March. In September it reappeared, and by November it was abundant (Fig. 4). It is therefore a species which developed rapidly in the post-monsoon period with the advent of more settled conditions and longer hours of sunshine.

**Pediastrum**—*Pediastrum tetras* was a constant form which was rare throughout the year, but became abundant in early February. The cold season was therefore favourable for its development. The other two species of *Pediastrum* occurred in the monsoon during a spell of bright sunshine after days of heavy rain. They disappeared as soon as another period of excessive rain set in.

A consideration of this order brings out some interesting facts. Some of its members may occur in the monsoon, but they disappear very soon, and cannot develop to any considerable extent. Most of them attain their greatest development in December or January during the early part of the cold season. It seems as if the low temperature of this period, together with the large amount of dissolved oxygen and high pH, support their growth. Griffiths (1923) found them in places where the oxygen content of the water is relatively high. Howland (1931) found them when pH, water level and salt concentration are moderately high. Both their results are confirmed here.

### CHAETOPHORALES

**Aphanochaete repens**—It was observed as an epiphyte on *Oedogonium*. It showed a certain amount of relation to the periodicity of its host; but unlike *Oedogonium*, it was not seen throughout the year.

**Coleochaete scutata**—It was epiphytic on the leaves of *Potamogeton* in early February. It developed best in late March, and disappeared by April. Howland (1931) found that it favoured high pH. Here too the pH was high when it thrived.

The *Chaetophorales* developed towards the end of the cold season and the beginning of the hot season, and the conditions necessary for their growth seemed to be the same as those for their hosts.

#### OEDOGONIALES.

**Oedogonium**—Five species of *Oedogonium* were recorded from the tank, but only two of them were *constant*. All of them began to reproduce sexually in March and April. In May they appeared to be in a definitely unhealthy condition. With the rains however, they seemed to revive and the two constant species formed oogonia again. Both these species had two reproductive phases (Fig. 5). Ström (1924) remarks that two conjugation maxima annually are in a period of great vegetative activity in a spell of bright weather after

A belief held by the early algologists was that the lower forms enter into the reproductive stage at the end of their vegetative activity. It has however been found that phases of reproduction may coincide with periods of greatest vegetative activity. In this tank the first reproductive phase of *Oedogonium* occurred at the end of vegetative activity, when the sunshine was abundant, the pH fairly high, the concentration of water and carbon dioxide increasing and oxygen content decreasing. The second reproductive phase occurred during a period of great vegetative activity in a spell of bright weather after excessive rain. Brown (1908) has shown that a sudden change in external conditions can check the growth of an alga and cause it to fruit sexually. The sudden change in the environmental conditions probably influenced the second reproductive phase.

**Bulbochaete**—It was seen in December and reached its maximum in January (Fig. 5). The conditions which favoured its growth and development seemed to be the same as those for the Chlorococcales.

#### CONJUGATAE (ZYGNEACEAE).

**Zygnema**—It occurred in December and became very abundant by January. The curves of *Bulbochaete* and *Zygnema* were almost similar (Fig. 5) and the same conditions seemed favourable to both. Hodgetts (1921) found that there was no relationship between *Zygnema* and bright sunshine unless abundant bright sunshines were harmful to it. In this tank *Zygnema* appeared when the hours of bright sunshine were moderately high, and disappeared when they became longer, but temperature seemed to be a more important factor influencing its appearance.

**Spirogyra**—Two species of *Spirogyra*, one fertile, the other sterile, were common in February. *Spirogyra formosa* formed zygospores in late February or early March, after which it disappeared. It was also seen in the monsoon.

The conditions necessary for the development of *Spirogyra* were almost the same as for *Oedogonium*. Other workers have seen that each time *Spirogyra* became abundant, *Oedogonium* followed suit, and both may even fruit simultaneously. Here also the same relation between the two genera was noticeable.

A few sterile filaments of *Mougeotia* were seen intermixed with *Spirogyra*.

#### DESMIDIACEAE.

**Desmids.**—Though the desmids were best represented qualitatively, very few of them were abundant at any time. Only a few occurred in noticeable numbers. Ström (1924) found that two factors are hostile for the occurrence of desmids in large quantities as plankton organisms—contamination and the basic reaction of the water, viz. pH conspicuously greater than 7. Slight contamination does not affect them much, but serious contamination renders desmid growth impossible.

As the desmids occurred in relatively few numbers, it is impossible to put forward any views with regard to the factors influencing their growth. Most



of them were characteristic of the cold season and occurred when the pH and the amount of dissolved oxygen were very high, free carbon dioxide absent, nitrates and albuminoid ammonia very low, oxidizable organic matter fairly low and the water dilute. The meteorological conditions favourable for their growth were no rainfall, fairly long hours of sunshine and low temperature.

#### HETEROKONTAE.

The only member of this group was *Botryococcus Braunii* which also seemed to prefer the cold season.

#### EUGLENINEAE.

**Euglena**—A number of species of *Euglena* were present in the tank. With the exception of *Euglena acus* which was seen in the monsoon, all of them seemed to thrive in the hot season when there was a large amount of organic matter present. Fritsch and Rich (1913) also found that the maximum of *Euglena viridis* coincided with an enrichment of the water with organic matter and Lind (1938) found *Euglena* abundant when albuminoid ammonia was maximum.

**Trachelomonas**—All the species of *Trachelomonas* occurred in the hot season, and disappeared in July. Howland (1931) did not find *Trachelomonas volvocina* and *T. hispida* when organic contamination was greatest and saw no evident relation between their presence and salt concentration. Hodgetts (1922) however, found that abundant sunshine together with a high salt concentration was favourable to them. In this case they were present when there was abundant sunshine, large amount of organic matter and in very concentrated water.

The flagellates therefore seemed to favour high temperature, great light intensity and no rain. They appeared when there was a large amount of decaying vegetation and consequently much organic matter in the tank. They were not wiped out entirely by heavy rain, but persisted for some time.

#### MYXOPHYCEAE.

**Lyngbya**—Two species of *Lyngbya* usually occurred together in the tank. The curve for the first viz. *Lyngbya aestuarii* was almost similar to that for *Oedogonium iowense* (Fig. 5). It was thus influenced by the same factors as *Oedogonium* except that it was more unsuited to the cold season. Moreover it was unable to thrive in the latter part of the monsoon and soon disappeared.

*Lyngbya Birgei* was the second species. It was very abundant in March and remained so till July (Fig. 5). It decreased in numbers during the latter part of the monsoon. It was typical of the hot season, and favoured the same conditions as the flagellates.

**Oscillatoria**—Four species of *Oscillatoria* were seen in the tank. All of them, with the exception of *Oscillatoria gloeophila* which was found in the hot season, were found in the monsoon when the water was fairly dilute. They were however never seen in abundance.

**Anabaena**. Two, out of the three species of *Anabaena*, were fertile. *A. Fullebornii* occurred in September and formed spores in October. It persisted till March. *A. Fertilissima* was seen during the monsoon as a rare species, but it became abundant in January. Whenever it was seen, it was forming spores. Thus it was probably a type which did not remain long in the vegetative condition, but formed spores at once.

**Aulosira**. Filaments of *Aulosira fertilissima* occurred densely intertwined forming mats which seemed like decaying leaves. By September and October the species was very abundant and had formed spores, every alternate cell of the filament being transformed into a spore.

**Coelosphaerium.** It was seen throughout the year, but was abundant from the end of March till the end of May. It persisted during the monsoon as a rather common form but became rare in October (Fig. 5). The other genera were only seen in the hot season.

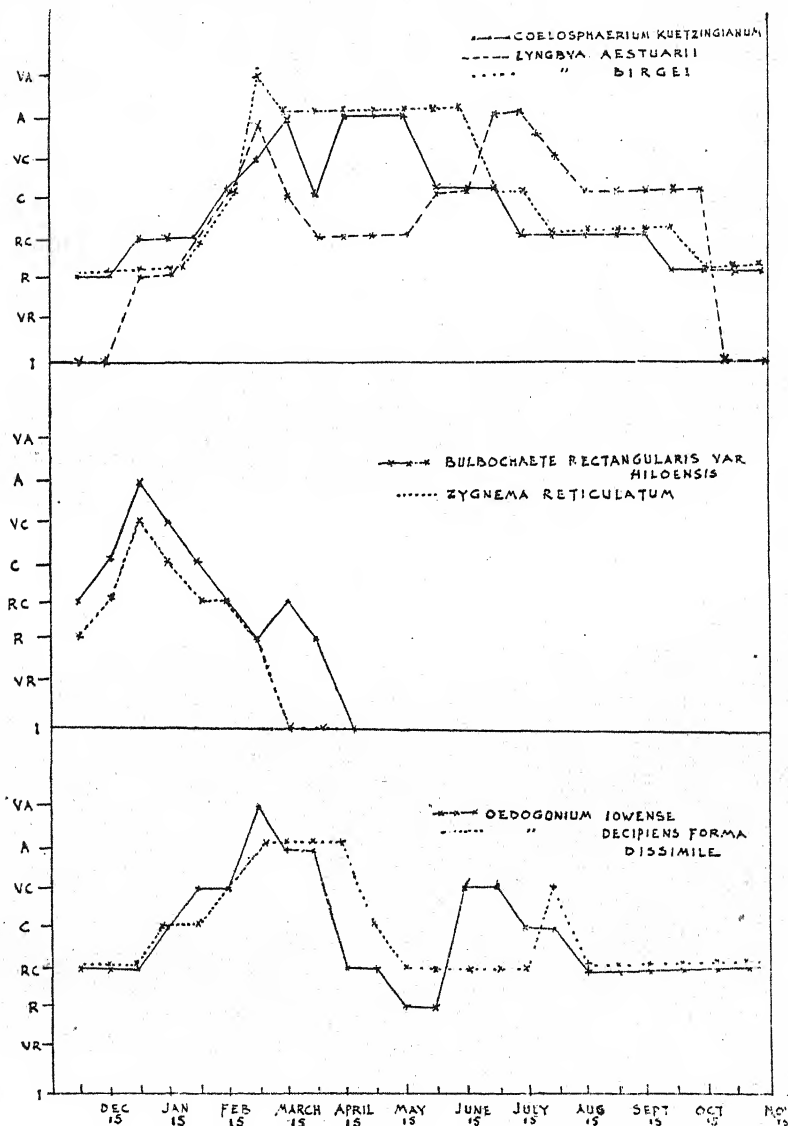


Fig. 5.—Frequency-graphs of some of the algae in the Bandra Tank

A consideration of the Myxophyceae brings out the fact that most of them like the flagellates, occur in May. High temperature seems to be the deciding factor for their good development. This is also shown by the fact that some

of the Myxophyceae like *Aulosira*, *Gloeotrichia* etc. develop in October when the temperature and temperature variations are the same as in May. Thus most of the Myxophyceae favour high temperature; but some of them can only thrive when there is a considerable amount of organic matter present in the water and when the concentration of dissolved salts is fairly high. Other species can thrive in more dilute waters. Only a few forms like *Calothrix marchica* var. *crassa* and *Anabaena fertilissima* are seen in the cold season.

#### SUMMARY.

1. This paper deals with the seasonal succession of the algae in a tank at Bandra and the relation of the algal flora to the chemical constitution of the water and the meteorological conditions.
2. The algae were collected at fortnightly intervals for a year, and the water was analysed once a month.
3. The water level at the close of the hot season was very low and there was an increase in all the salts. The first rains did not make much difference in the amount of dissolved solids; but later, as the water level increased, there was a decrease in all salts till a minimum was reached in the middle of the monsoon. As the monsoon abated, there was a rise in the dissolved solids.
4. The number of algal species observed in the tank was 103. Of these, 8 were *constant*, 42 *intermediate* and the rest were *ephemerals*.
5. The majority of the species were seen in the cold season, which was characterised by the predominance of members of the Chlorophyceae. They grew luxuriantly and many species reproduced themselves. In the hot season, members of the Myxophyceae and Englenineae thrived. The least number of species was seen in the monsoon. During the October-November period, there were more species than in the rainy season, and the period was also characterised by the appearance of a number of members belonging to the Myxophyceae.
6. By noting the condition of the weather and water when some of the more important species appeared, the local conditions favourable for their growth are determined.

#### ACKNOWLEDGMENT.

The authors wish to express their sincere thanks to Prof. V. V. Apte, Fergusson College, Poona, for the kind loan of a number of important books helpful in identifying the algal specimens; to Dr. S. R. Savur of the Colaba Observatory, Bombay, for furnishing the meteorological data; to Dr. S. B. Setna, Director of Fisheries, Bombay, for supplying details of the Bandra Tank and to Messrs. Habbu and R. B. M. Colah for help in calculating the results of Chemical Analysis statistically.

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## APPENDIX I.

Month.	pH	Dissolved Oxygen.	Free CO <sub>2</sub> .	Total Solids.	Total Hardness.	Organic matter	Free Ammonia.	Albuminoid Ammonia.	Nitrates.	PO <sub>4</sub> .	Cl.	Bicarbonate.	Carbonates.	Temperature.	Sunshine.	Rainfall.
1940— December	8.02	7.58	.22	28.57	11	.371	.0166	.071	.023	.00495	5	21.65	..	77.45	10	Nil
1941— January ...	8.36	7.76	Nil	30.2	12	.441	.0124	.086	.018	.00416	5.56	22	1.4	73.86	9.7	0.07
February	8.95	10.003	Nil	27.4	11	.421	.007	.036	.009	.00436	6.52	14.58	2.8	77.9	9.7	Nil
March ...	8.37	3.19	Nil	34.2	11	.522	.006	.037	.017	.0054	7.14	25.86	0.4	79.03	9.7	"
April ...	7.88	4.53	1.7	43.8	16	.511	.024	.057	.047	.0045	10.76	27.87	..	84.77	9.8	"
May ...	7.41	3.12	3.3	61.42	17	.612	.012	.087	.064	.0046	10.27	30.05	..	86.37	10.7	"
June ...	8.17	5.54	.7	60.5	18	.585	.028	.097	.084	.0054	6.68	19.66	..	86.68	6.9	10.33
July ...	7.95	5.69	.5	45.2	15	.371	.038	.089	.091	.0065	2.18	13.6	..	82.43	3.9	11.79
August ...	7.67	5.55	.91	42.38	13	.142	.028	.061	.072	.0051	3.56	14.25	..	84.84	3.1	5.83
September	7.8	4.7	.93	40.25	13	.281	.012	.068	.052	.006	5.32	14.24	..	82.43	7.2	6.17
October ...	8.12	4.03	.4	43.12	14	.42	.017	.101	.044	.0062	7.85	14.9	..	84.94	9.7	Nil
November	7.81	4.9	.3	44.25	15	.481	.015	.111	.032	.0055	8.12	15.575	..	83.76	9.5	"

## APPENDIX—II.

## THE ALGAL FLORA OF THE TANK.\*

## ISOYONTAE : (CHLOROPHYCEAE).

## VOLVOCALES.

1. *Gloeocystis vesiculosa* Näg. (i).
2. *Pandorina morum* (Mull.) Bory (e), (d).

## CHLOROCOCCALES.

3. *Pediastrum tetras* (Ehr.) Ralfs., (i).
4. *Pediastrum duplex* Meyen var. *genuinum* A. Br. (e).
5. *Pediastrum clathratum* (Sch.) Lemm. (e).
6. *Sorastrum spinulosa* Näg. (e).
7. *Trochiscia obtusa* (Reinsch) Hansg. (e).
8. *Oocystis solitaria* Wittr. (i).
9. *Oocystis elliptica* W. West. (i).
10. *Oocystis lacustris* Chodat. (e).
11. *Gloeotaenium Loitlesbergerianum* Hansg. (c), (d).
12. *Tetraedron muticum* (A. Br.) Hansg. forma *minimum* Reinsch. (e).
13. *Tetraedron trilobatum* (Reinsch) Hansg. (e).
14. *Tetraedron trigonum* (Näg) Hansg. forma *gracile* Reinsch. (e).
15. *Ankistrodesmus falcatus* (Corda) Ralfs. (e).
16. *Ankistrodesmus spiralis* (Turner) Lemm. (e).
17. *Selenastrum gracile* Reinsch. (i).
18. *Kirchneriella lunaris* (Kirchner) Mob. (e).
19. *Westella botryoides* (W. West) Schmidle. (e).
20. *Dimorphococcus lunatus* A. Br. (e).
21. *Scenedesmus obliquus* (Turpin) Kütz. (i).
22. *Scenedesmus brasiliensis* Bohlén. (i).
23. *Scenedesmus quadricauda* (Turpin) Bréb. (i).
24. *Coelastrum cambricum* Archer. (i).

## CHAETOPHORALES.

25. *Aphanochaete repens* A. Br. (i).
26. *Coleochaete scutata* Bréb. (e).

## OEDOGONALES.

27. *Oedogonium varians* Wittr. (e).
28. *Oedogonium decipiens* Wittr. forma *dissimile* Hirn. (c), (d).
29. *Oedogonium iowense* Tiffany. (c), (d).
30. *Oedogonium longicolle* Nordst. (e).
31. *Oedogonium inconspicuum* Hirn. (e).
32. *Bulbochaete rectangularis* Wittr. var. *hiloensis* Nordst. (i).

## CONJUGATAE.

33. *Zygnema reticulatum* Hallas. (i).
34. *Spirogyra formosa* (Transeau) Czurda. (c).
35. *Spirogyra* sp. (e).
36. *Mougeotia* sp. (i).
37. *Closterium Venus* Kütz. (i).
38. *Closterium Acerosum* (Schr.) Ehr. (e).
39. *Closterium Leibleinii* Kütz. (i).
40. *Closterium Dianae* Ehr. (e).

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\* The classification followed is that of West and Fritsch as given in 'A Treatise on the British Freshwater Algae'. 1927. 'c' denotes 'constant', 'i' denotes 'intermediate', 'e' denotes 'ephimeral' and 'd' denotes 'dominant' species.

41. *Closterium* sp. (new). (e).
42. *Closterium* sp. (new). (e).
43. *Closterium eboracense* Turn. (e).
44. *Euastrum substellatum* Nordst. (i).
45. *Euastrum bidentatum* Näg. (e).
46. *Micrasterias pinnatifida* (Kütz) Ralfs. (e).
47. *Cosmarium Lundellii* Delp. var. *ellipticum* West. (i).
48. *Cosmarium Portianum* Arch. (i).
49. *Cosmarium Quadrum* Lund. (i), (d).
50. *Cosmarium Sublatere-undatum* West & West. (i).
51. *Cosmarium Meneghinii* Bréb. (i).
52. *Cosmarium abruptum* Lund. (i).
53. *Cosmarium asphaerosporum* Nordst. (i).
54. *Cosmarium divergens* Krieger (new var.). (i).
55. *Cosmarium sexnotatum* Gutw., var. *tristriatum* (Lutkem Schmidle.) (i).
56. *Cosmarium Phaseolus* Bréb. var. *elevatum* Nord. (i).
57. *Cosmarium cucumis* (Corda) Ralfs. var. *magnum* Racib. (i).
58. *Cosmarium angulatum* (Perty) Rabent. forma *major* Grunow. (i).
59. *Cosmarium contractum* Kirch. var. *ellipsoideum* (Elf.) West & West. (i).
60. *Cosmarium cymatopleurum* Nord. (i).
61. *Cosmarium subimpressulum* Borge. (e).
62. *Cosmarium granatum* Bréh. (i).
63. *Arthrodesmus convergens* Ehr. (e).
64. *Staurastrum alternans* Bréb. (i).
65. *Staurastrum crenulatum* (Näg.) Delp. (e).
66. *Staurastrum gracile* Ralfs. (i).
67. *Sphaerosoma granulatum* Roy and Biss. (e).

## HETEROKONTAE.

## HETEROCAPSINEAE.

68. *Botryococcus Braunii* Kütz. (i).

## EUGLENINBAE.

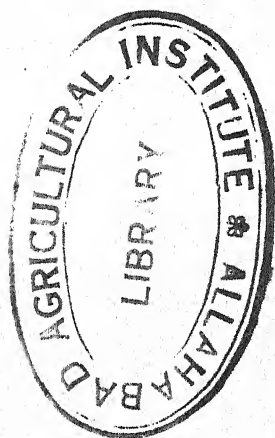
## EUGLENACEAE.

69. *Euglena Ehrenbergii* Klebs. (i).
70. *Euglena acus* Ehr. (i).
71. *Euglena deses* Ehr. (e).
72. *Euglena proxima* Ehr. (i).
73. *Euglena oxyuris* Schmarda. (e).
74. *Lepocinclis ovum* (Ehr) Lemm. (e).
75. *Lepocinclis Butschli* Lemm. (e).
76. *Lepocinclis Butschli* Lemm var. *angustata* Deflandre. (e).
77. *Phacus orbicularis* Hub. (i).
78. *Trachelomonas horrida* Palmer var. *crenulatocollis* Skuor. (e).
79. *Trachelomonas armata* Ehr. var. *Steinii* Lemm. (e).
80. *Trachelomonas similis* Stokes. (e).
81. *Trachelomonas volvocina* Ehr. (e).

## MYXOPHYCEAE (CYANOPHYCEAE).

## CHROOCOCCALES.

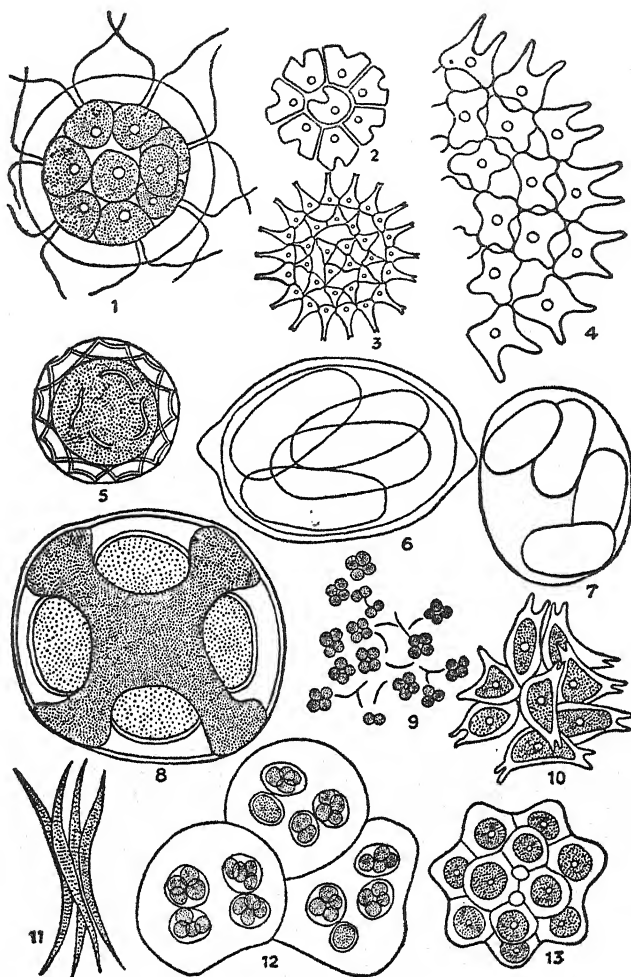
82. *Aphanothece pallida* (Kütz.) Rabh. (i).
83. *Coelosphaerium Kuetzingianum* Näg. (c), (d).
84. *Microcystis stagnalis* Lemm. (i).
85. *Microcystis flos-aquae* (Witttr.) Kirchn. (e).
86. *Aphanocapsa elachista* W & G.S. West var. *Conferta* W & G.S. West. (c).
87. *Chroococcus turgidus* (Kütz.) Näg. (i).





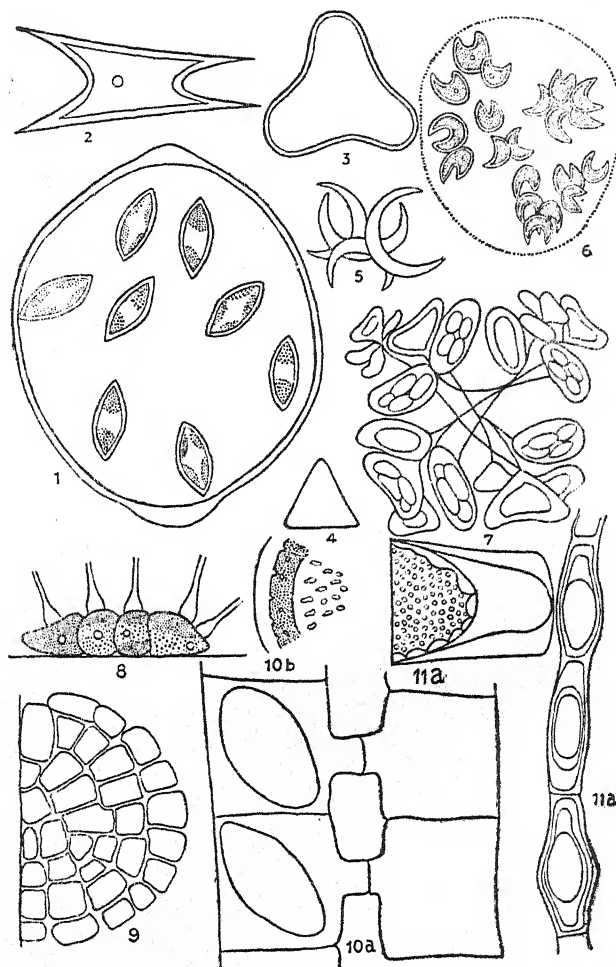
## HORMOGONEALES.

88. *Oscillatoria gloeophila* Grun. (c).
89. *Oscillatoria sancta* Kütz. (e).
90. *Oscillatoria chalybea* Mert. (e).
91. *Oscillatoria tenuis* Ag. (e).
92. *Spirulina subtilissima* Kütz. (e).
93. *Spirulina Major* Kütz. (e).
94. *Lyngbya aestuarii* (Mert.) Lie. (e).
95. *Lyngbya Birgei* Smith. (c).
96. *Schizothrix lacustris* A. Br. (e).
97. *Anabaena fertilissima* Rao. (e).
98. *Anabaena Füllebornii* Schmidle. (e).
99. *Anabaena* sp. (e).
100. *Aulosira fertilissima* Ghose. (e).
101. *Tolypothrix distorta* (Fl. D.) Wartm. (e).
102. *Calothrix marchica* LemG. var. *crassa* Rao. (e).
103. *Gloeotrichia Raciborskii* Wolos. (e).



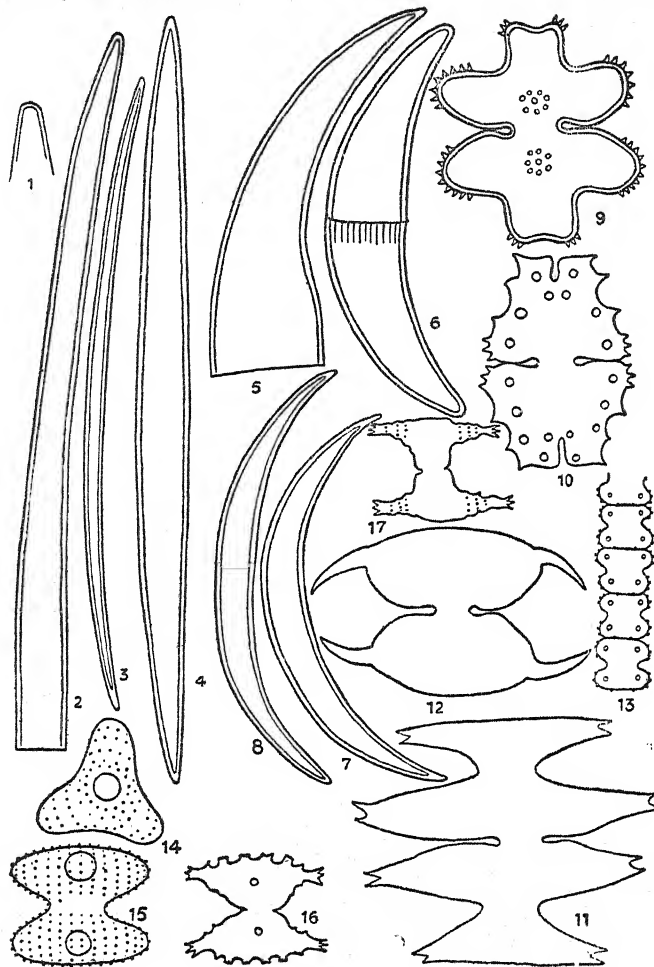
## BOMBAY ALGAE.

- Fig. 1.—*Pandorina morum* (Muller) Bory. ( $\times 406$ ).  
 Fig. 2.—*Pediastrum tetras* (Ehr.) Ralfs. ( $\times 406$ ).  
 Fig. 3.—*Pediastrum clathratum* (Schroeter) Lemm. ( $\times 262$ ).  
 Fig. 4.—*Pediastrum duplex* Meyen var. *genuinum* A. Br. ( $\times 406$ ).  
 Fig. 5.—*Trochiscia obtusa* (Reinsch) Hansg. ( $\times 406$ ).  
 Fig. 6.—*Oocystis solitaria* Wittr. ( $\times 406$ ).  
 Fig. 7.—*Oocystis elliptica* W. West. ( $\times 406$ ).  
 Fig. 8.—*Gloeotaenium Loitlesbergerianum* Hansg. ( $\times 406$ ).  
 Fig. 9.—*Westella botryoides* (W. West) de Wildom. ( $\times 406$ ).  
 Fig. 10.—*Sorastrum spinulosa* Näg. ( $\times 406$ ).  
 Fig. 11.—*Ankistrodesmus falcatus* (Corda) Ralfs. ( $\times 406$ ).  
 Fig. 12.—*Gloeocystis vesiculosa* Näg. ( $\times 262$ ).  
 Fig. 13.—*Coelastrum cambricum* Archer. ( $\times 182$ ).



## BOMBAY ALGAE.

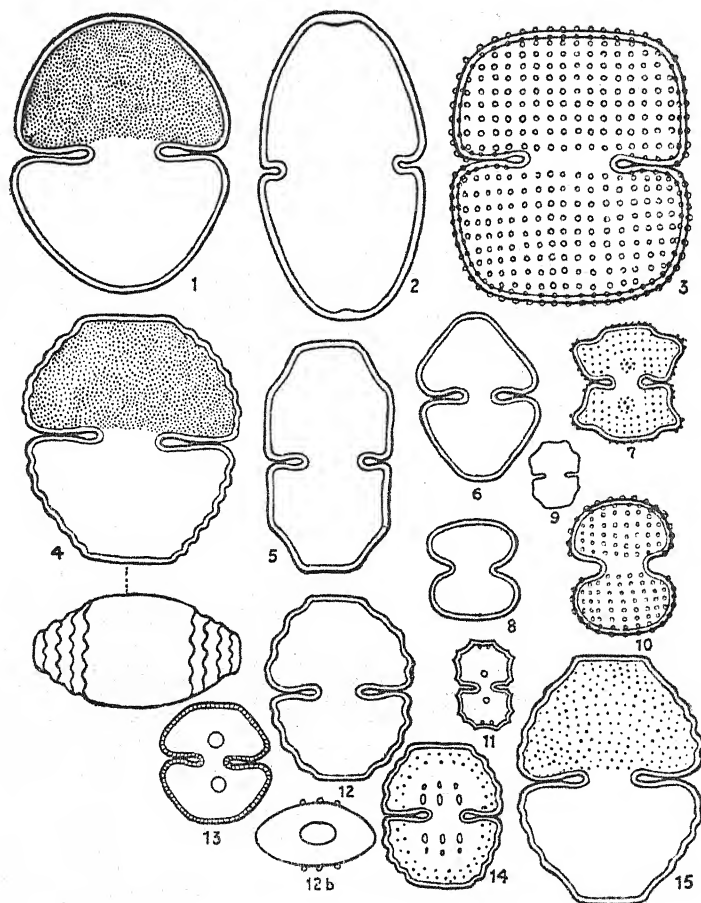
- Fig. 1.—*Oocystis lacustris* Chodat. ( $\times 406$ ).  
 Fig. 2.—*Tetraedron trigonum* (Näg) Hansg. forma *gracile* Reinsch. ( $\times 406$ ).  
 Fig. 3.—*Tetraedron trilobatum* (Reinsch) Hansg. ( $\times 406$ ).  
 Fig. 4.—*Tetraedron muticum* (A. Br.) Hansg. forma *minimum* Reinsch. ( $\times 406$ ).  
 Fig. 5.—*Selenastrum gracile* Reinsch. ( $\times 406$ ).  
 Fig. 6.—*Kirchneriella lunaris* (Kirchner.) Moebius. ( $\times 406$ ).  
 Fig. 7.—*Dimorphococcus lunatus* A. Br. ( $\times 406$ ).  
 Fig. 8.—*Aphanochaete repens* A. Br. ( $\times 406$ ).  
 Fig. 9.—*Coleochaete scutata* bréb. ( $\times 262$ ).  
 Fig. 10a.—*Spirogyra formosa* (Transeau) Czurda. ( $\times 262$ ).  
     (portion of conjugating filament).  
 Fig. 10b.—Surface view of the mesospore of No. 10a. ( $\times 406$ ).  
 Fig. 11a.—*Zygnema reticulatum* Hallas (showing parthenospores). ( $\times 182$ ).  
 Fig. 11b.—Surface view of the mesospore of No. 11a. ( $\times 406$ ).



## BOMBAY ALGAE.

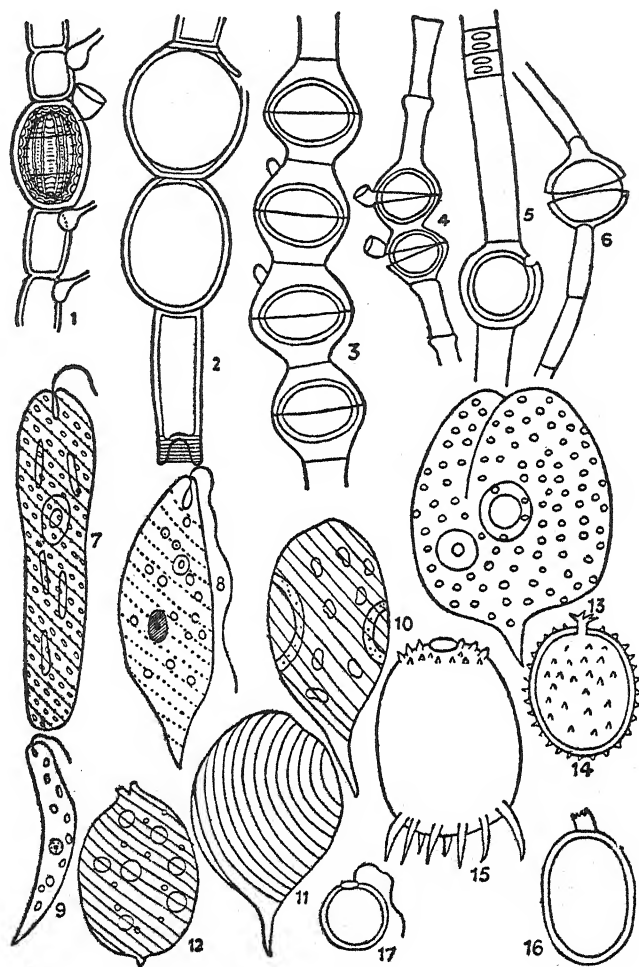
- Fig. 1.—*Closterium* sp. (new species) Extremity of the cell. ( $\times 262$ ).  
 Fig. 2.—*Closterium* sp. (new species) Semicell. ( $\times 52$ ).  
 Fig. 3.—*Closterium* sp. (new species). ( $\times 24$ ).  
 Fig. 4.—*Closterium acerosum* (Schr.) Ehr. var. *elongatum* Breb. ( $\times 40$ ).  
 Fig. 5.—*Closterium Leibleini* Kütz. ( $\times 406$ ).  
 Fig. 6.—*Closterium* sp. (new species). ( $\times 182$ ).  
 Fig. 7.—*Closterium Venus* Kütz. ( $\times 406$ ).  
 Fig. 8.—*Closterium Dianae* Ehr. ( $\times 406$ ).  
 Fig. 9.—*Euastrum substellatum* Nordst. ( $\times 406$ ).  
 Fig. 10.—*Euastrum bidentatum* Näg. ( $\times 406$ ).  
 Fig. 11.—*Micrasterias pinnatifida* (Kütz.) Ralfs. ( $\times 406$ ).  
 Fig. 12.—*Arthrodesmus convergens* Ehr. ( $\times 406$ ).  
 Fig. 13.—*Sphaeroszoma granulatum* Roy and Biss. ( $\times 406$ ).  
 Fig. 14.—*Staurastrum alternans* Bréb. ( $\times 406$ ).  
 Fig. 15.—*Staurastrum alternans* (vertical view). ( $\times 406$ ).  
 Fig. 16.—*Staurastrum crenulatum* (Näg.) Delp. ( $\times 406$ ).  
 Fig. 17.—*Staurastrum gracile* Ralfs. var. *nanum* Wille. ( $\times 406$ ).

\* This sp. appears to be a new species of *Closterium* and will be described in another paper.



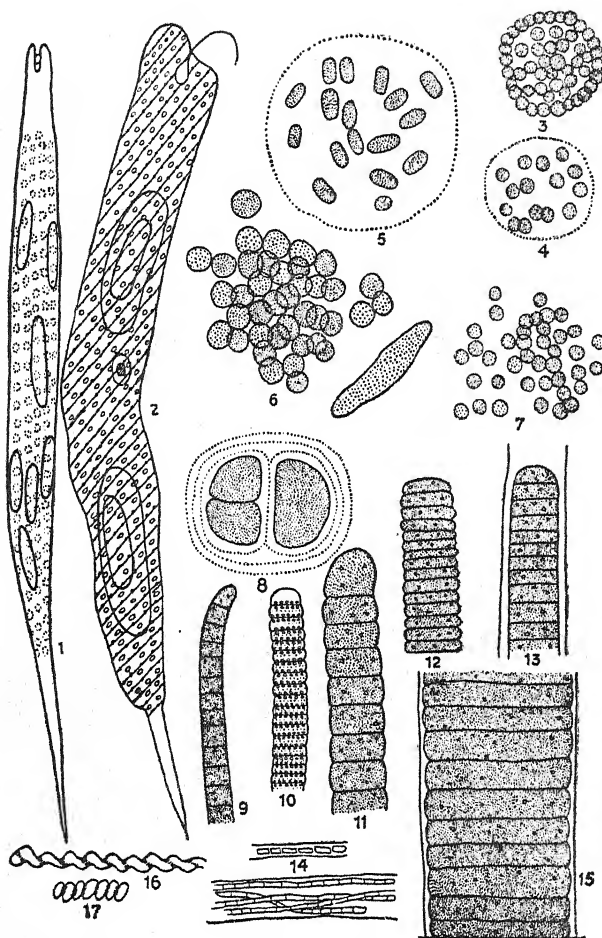
## BOMBAY ALGAE.

- Fig. 1.—*Cosmarium Lundelii* Delp. var. *ellipticum* West. ( $\times 406$ ).  
 Fig. 2.—*Cosmarium cucumis* (Corda) Ralfs. var. *magnum* Racib. ( $\times 262$ ).  
 Fig. 3.—*Cosmarium Quadrum* Lund. ( $\times 406$ ).  
 Fig. 4.—*Cosmarium sublatere-undatum* West & West (new var.) Front and vertical views. ( $\times 406$ ).  
 Fig. 5.—*Cosmarium angulatum* (Perty Rabenh. forma *major* Grunow. ( $\times 182$ ).  
 Fig. 6.—*Cosmarium granatum* Bréb. ( $\times 406$ ).  
 Fig. 7.—*Cosmarium divergens* Krieger (new var.). ( $\times 406$ ).  
 Fig. 8.—*Cosmarium contractum* Kirch. var. *ellipsoideum* (Elfv.) West & West. ( $\times 406$ ).  
 Fig. 9.—*Cosmarium Meneghinii* Bréb. ( $\times 406$ ).  
 Fig. 10.—*Cosmarium Portianum* Arch. ( $\times 406$ ).  
 Fig. 11.—*Cosmarium abruptum* Lund. ( $\times 406$ ).  
 Fig. 12a.—*Cosmarium subimpressulum* Borge. ( $\times 406$ ).  
 Fig. 12b.—*Cosmarium subimpressulum* (vertical view). ( $\times 406$ ).  
 Fig. 13.—*Cosmarium phaseolus* Bréb. var. *elevatum* Nordst. ( $\times 406$ ).  
 Fig. 14.—*Cosmarium sexnotatum* Gutw. var. *tristriatum* (Lutkem.) Schmidle. ( $\times 406$ ).  
 Fig. 15.—*Cosmarium cymatopleurum* Nordst. ( $\times 406$ ).



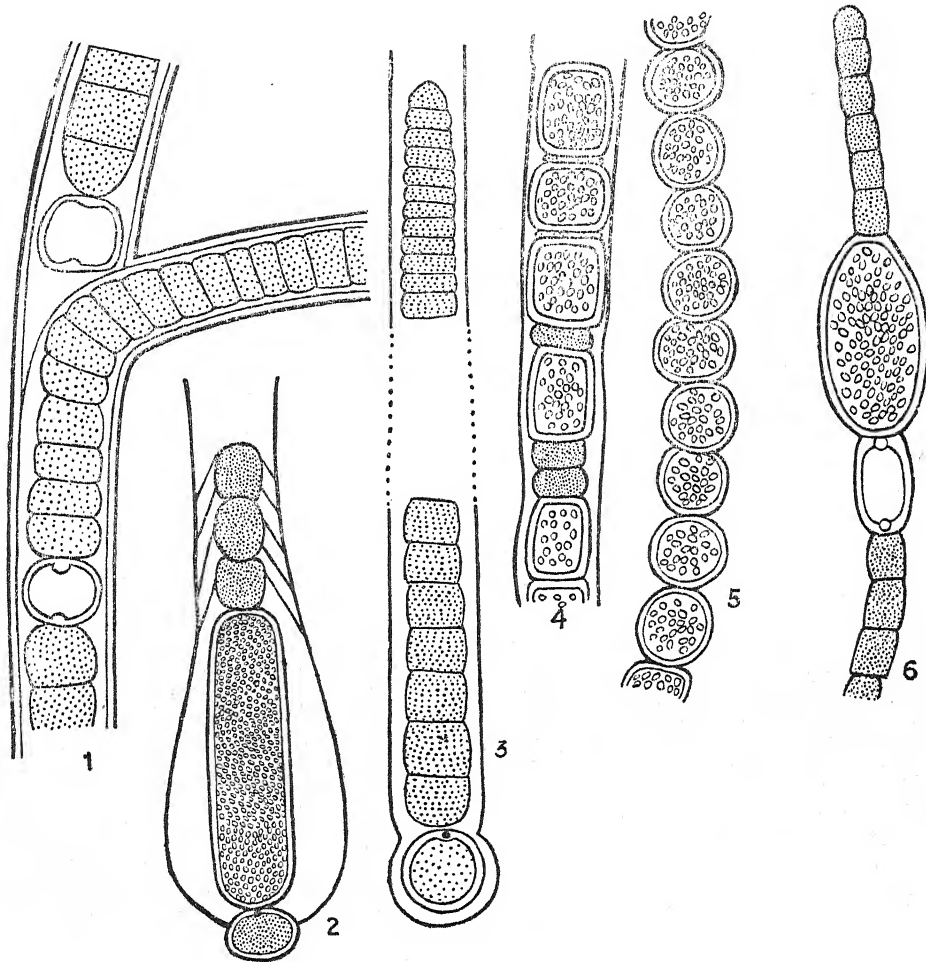
## BOMBAY ALGAE.

- Fig. 1.—*Bubochaete rectangularis* Wittr. var. *hiloensis* Nordst. ( $\times 406$ ).  
 Fig. 2.—*Oedogonium iowense* Tiffany. ( $\times 182$ ).  
 Fig. 3.—*Oedogonium longicolle* Nordst. ( $\times 406$ ).  
 Fig. 4.—*Oedogonium decipiens* Wittr. forma *dissimile* Hirn. ( $\times 182$ ).  
 Fig. 5.—*Oedogonium varians* Wittr. & Lund. ( $\times 182$ ).  
 Fig. 6.—*Oedogonium inconspicuum* Hirn. ( $\times 406$ ).  
 Fig. 7.—*Euglena Ehrenbergii* Klebs. ( $\times 182$ ).  
 Fig. 8.—*Euglena proxima* Ehr. ( $\times 406$ ).  
 Fig. 9.—*Euglena deses* Ehr. ( $\times 182$ ).  
 Fig. 10.—*Lepocinclis Bütschli* Lemm. ( $\times 406$ ).  
 Fig. 11.—*Lepocinclis Bütschli* Lemm. var. *angustata* Delf. ( $\times 406$ ).  
 Fig. 12.—*Lepocinclis ovum* (Ehr.) Lemm. ( $\times 406$ ).  
 Fig. 13.—*Phacus orbicularis* Hub. ( $\times 406$ ).  
 Fig. 14.—*Trachelomonas horrida* Palmer var. *crenulatocollis* Skvor. ( $\times 406$ ).  
 Fig. 15.—*Trachelomonas armata* Ehr. var. *Steinii* Lemm. ( $\times 406$ ).  
 Fig. 16.—*Trachelomonas similis* Stokes. ( $\times 406$ ).  
 Fig. 17.—*Trachelomonas volvocina* Ehr. ( $\times 406$ ).



## BOMBAY ALGAE.

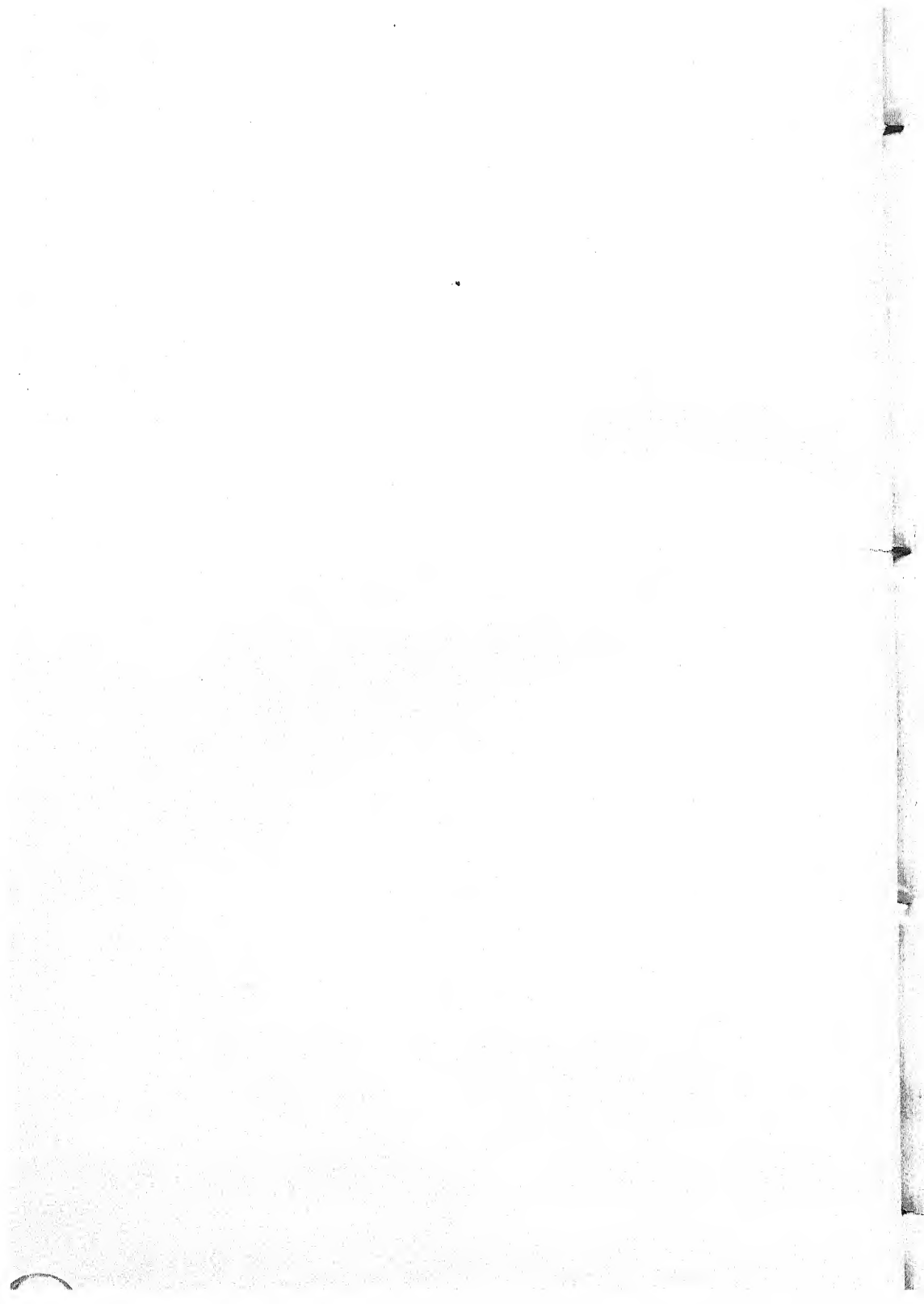
- Fig. 1.—*Euglena acus*. Ehr. ( $\times 406$ ).  
 Fig. 2.—*Euglena oxyuris* Schmarda. ( $\times 262$ ).  
 Fig. 3.—*Coelosphaerium Kuetsingianum* Näg. ( $\times 406$ ).  
 Fig. 4.—*Aphanocapsa ellachista* W. & G. S. West var. *conferta*. ( $\times 406$ ).  
 Fig. 5.—*Aphanothece pallida* (Kütz.) Rab. ( $\times 406$ ).  
 Fig. 6.—*Microcystis flos-aquae* (Witt.) Kirch. ( $\times 406$ ).  
 Fig. 7.—*Microcystis stagnalis* Lemm. ( $\times 406$ ).  
 Fig. 8.—*Chroococcus turgidus* (Kütz.) Näg. ( $\times 406$ ).  
 Fig. 9.—*Oscillatoria gloeophila* Grun. ( $\times 406$ ).  
 Fig. 10.—*Oscillatoria tenuis* Ag. ( $\times 406$ ).  
 Fig. 11.—*Oscillatoria chalybea* Mert. ( $\times 406$ ).  
 Fig. 12.—*Oscillatoria sancta* Kütz. ( $\times 406$ ).  
 Fig. 13.—*Lyngbya aestuarii* (Mert.) Lemm. ( $\times 182$ ).  
 Fig. 14.—*Schizothrix lacustris* A. Br. ( $\times 406$ ).  
 Fig. 15.—*Lyngbya Birgei* Smith. ( $\times 406$ ).  
 Fig. 16.—*Spirulina subtilissima* Kütz. ( $\times 406$ ).  
 Fig. 17.—*Spirulina major* Kütz. ( $\times 406$ ).



## BOMBAY ALGAE.

- Fig. 1.—*Tolypothrix distorta* (Fl. Dan.) Wartm. ( $\times 406$ ).  
 Fig. 2.—*Gloeotrichia Raciborskii* Wolos. ( $\times 406$ ).  
 Fig. 3.—*Calothrix marchica* Lemm. var. *crassa*. Rao. ( $\times 406$ ).  
 Fig. 4.—*Aulosira fertilissima* Ghose (showing spores). ( $\times 406$ ).  
 Fig. 5.—*Anabaena fertilissima* Rao. ( $\times 406$ ).  
 Fig. 6.—*Anabaena Füllebornii* Schmidle. ( $\times 406$ ).





## MISCELLANEOUS NOTES.

### I.—RARITY OF MAN-EATING TIGERS IN SOUTH INDIA.

In your April 1945 number Lt.-Col. E. O'Brien raises a question which has puzzled many. Why are Man-eaters so rare in South India?

There have been, and may still be, many man-eating tigers in the Ganjam District, of course, and part of this district is south of a line drawn due east from Bombay. Vizagapatam District has had its man-eaters, and also other parts of the 'Agency Tracts'.

The Nallamallais, Kurnool District, provided the man-eating tigress shot eventually at Diguvametta by the then Conservator of Forests in September 1923. She preyed upon the luckless railway gangmen; and this habit brought about her death. The Conservator was told to walk along the railway embankment keeping a sharp lookout on both sides. He soon spotted the tigress making for a culvert ahead of him. He walked towards the culvert, and then over to the other side of the embankment: and stopped. The tigress, misjudging his position, popped up ahead; and received her quietus. She was in good condition, but carried an old scar.

A man-eater roamed the Baragur Hills, to the east of the Biligirirangans (Coimbatore District), some 30 to 35 years ago; killing people spasmodically—about 4 or 5 a year. A Government Notification offering a reward for the brute described it as 'Ashy-grey, and somewhat stout'! It was said to have been shot by a poacher: if so it was quickly succeeded by another man-eater (not an unusual case) which also killed humans at infrequent intervals from Talamalai north-eastwards to Madeswaram-malai and Pon-nachi (Kollegal Taluk, Coimbatore District). Lt.-Col. R. E. Wright and I went after this tiger, reputed to have a kink in its tail. One night our camp was pitched in a field at the western foot of the Baragurs, an ill-chosen spot infested with masses of hairy-caterpillars. We went to sleep in two small tents facing each other, with a 'Petromax' lantern burning between the tents; and loaded rifles by our cots. I was awakened at midnight by a horrified yell from R.E.W. and rushing out, collided with him; on which he collapsed with laughter. Half-asleep he had imagined seeing a large form stealthily moving into his tent; it turned out to be the shadow cast by the petrol lamp on the wall of the tent, of a large caterpillar crawling over his bed clothes!

Now this tiger *was* shot by a poacher. Sallying forth after deer in the early morning he met the tiger round a corner, fired his muzzle loader at it, dropped the gun and fled like the wind. Later in the morning a Forest Guard and his watcher, on beat duty, came on the dead tiger, and recognized it as the man-eater. The gun was also recognized by the watcher who named its owner. So a bargain was struck. The poacher was told that he would not be reported for being in the Reserve Forest with an

unlicensed gun, provided the Forest Guard was given the skin and skull of the tiger. This was gladly agreed to by the poacher who had no idea that the tiger was a notified man-eater, with a reward of Rs. 300 on its head. The F. G. then proceeded to claim the reward, producing the skin and skull in the local Katchery together with a wonderful story of how he had killed the tiger single handed sitting up for it over a jungle path. The reward was about to be paid when the watcher learned that the F.G. intended to give him a mere pittance of the total. So the watcher then 'blew the gaff'. The only party to benefit was an unkind Government who, while pardoning the poacher for his activities, confiscated his gun and paid out no reward—the F.G. being sacked, and the tiger's skin and skull retained in the Katchery.

In more recent times, two years ago in fact, a tiger killed four or five people at the western foot of the Billigirirangans (Mysore District) and was finally shot by officials. Earlier this year a tiger killed three persons in the Talavadi firka, Gobichetty-palayam Taluk, and was finally shot in Mysore territory.

The foregoing still does not explain why there are fewer man-eaters in South India—but I think the answer possibly lies in a combination of circumstances. Continued existence of man-eaters in an area where both game animals and cattle exist in insufficient numbers, and where tiger are forced to remain instead of emigrating to more fruitful parts—as in the case of Ganjam for example. Sanderson's description of the Honganur (Mysore District) man-eating tigress (in his 'Thirteen Years among the Wild Beasts of India'), which he finally shot, is an example of the vice picked up by a tigress to provide easy food for her cubs in all probability. It is a recognised fact that the villagers and jungle tribes of South India have not got the 'guts' of those of Central and North India. They are less inclined to stand their ground on the appearance of tiger after their cattle, and in the proximity of a tigress with cubs. This I think, has resulted in more herdsmen and villagers being killed by tiger, or tigresses (so attaining an inherited taste for humans), in the Central and Northern parts of India.

HONNAMETTI ESTATE,

ATTIKAN P.O.,

VIA. MYSORE,

13th December 1945.

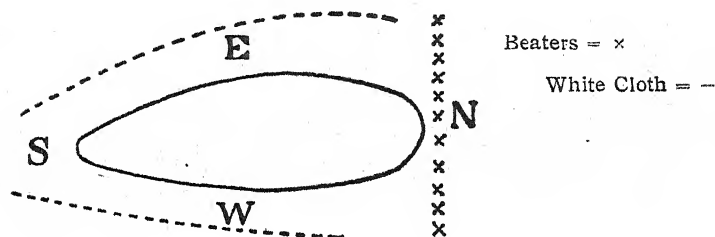
R. C. MORRIS.

## 2.—MAN-EATERS IN THE DARRANG DISTRICT, ASSAM

During the past two or three years nearly 50 people have been killed and eaten in this district. A kill would take place and when next heard of, the tiger would be a distance of nearly 10 miles away making it very difficult to bring the animal or (animals) as turned out to be, to bag.

A man was killed one evening and the next morning the villagers reported that the tiger was in their *bari*. On arrival at

the village, just off a main road—the men pointed to a small hedge of thatch and scrub jungle four feet wide and about the same in height. On approaching to within six feet I saw a tiger crouching. The tiger turned out to be an old emaciated male, 8' 10" in length, —blind in one eye and covered in old bullet and *dao* wounds. For a time killings ceased, but after a period of three months or so a man was reported killed. A few days afterwards villagers from near where the killing took place reported they had a tiger surrounded in a patch of jungle 5 or 6 acres in area. I lined the east and west side of the jungle with strips of white cloth put a line of drummers and beaters at the north end and waited in the neck at the south end.



Nothing happened until the beaters were half way through, then the tigress broke to the west, saw the white cloth, and entered the jungle again, after a short time it broke east then turned back into the jungle. When the beaters reached within 10 to 15 yards of the south end the tigress broke cover and came roaring towards me, when she was bowled over. A tigress in fair condition with L.G. wounds in her shoulder and blind in one eye!!!

A short time afterwards I was out on an elephant near where previous killings had taken place and came on a tigress which, after shooting, was found to be an eight feet old emaciated tigress, also blind in one eye.

No killings have taken place for 3 or 4 months and it looks as if the last of the man-eaters is accounted for.

The extraordinary thing is the three tigers being blind in one eye.

Have any of your readers heard of a similar case.

THE BORPUKHURIE TEA COMPANY, LTD.,  
MIJIKAJAN P.O. & T.O.,  
DISTRICT DARRANG, ASSAM,  
27th October 1945.

D. G. MESTON.

### 3.—DEATH OF A PANTHER ON A TIGER'S KILL.

On 30-3-33 I wrote a description of a tiger pouncing on a dead panther (which I had shot) on discovering it along-side his kill.

A dead panther, killed by a tiger (but not eaten) has been found within a few yards of the latter's kill here recently. The tiger had killed a cart-bull on a forest road and dragged it into the jungle. That night a panther located the kill, and, unaware of the tiger's approach, obviously fell an easy victim.

Some years ago I wrote a note on the more cautious behaviour of a panther which had designs on a tiger's kill. It climbed the tree on which I was sitting (together with a lady) and actually perched itself above us. I was terribly sleepy at that time; and, awakened by her nudge, and alarmed whisper of 'what's that above us?' I murmured 'only a panther' and drowsed off again—only to be properly awakened this time with a thump and loudly spoken 'How awful; wake up'! The panther leapt down off the tree; and the tiger did not turn up!

HONNAMETTI ESTATE,  
ATTIKAN P.O.,  
VIA. MYSORE, S. INDIA,  
10th December 1945.

R. C. MORRIS.

#### 4.—SENSE OF SMELL OF TIGER AND LEOPARDS.

There appears to be a lot of controversy over this. I have killed over fifty leopards and tigers from sitting in holes in the ground, have had tiger within a foot or so of me and only on one occasion has a tiger shown any interest.

After sniffing loudly several times, apparently satisfied, it proceeded to the kill, a dead buffalo.

I had over the hole (3' square) a few bamboos and a thin thatch covering, so had the animals' power of scent been at all good they would surely have detected me.

It would be interesting to hear of other readers experiences.

THE BORPUKHURIE TEA COMPANY, LTD.,  
MĪJIKAJAN P.O. & T.O.,  
DIST. DARRANG,  
ASSAM,  
10th October 1945.

D. G. MESTON.

#### 5.—MUSK-SHREW (*SUNCUS CAERULEUS*) ATTACKING BULL-FROG (*RANA TIGRINA*).

A few days ago, soon after sunset, as I was sitting in my garden, my attention was attracted by the rasping croak of a big frog in distress: This peculiar sound is usually emitted when frogs are caught or are in the act of being swallowed by snakes and monitor lizards. As it was then getting dark, I called for my car and directed the head-lights towards the hedge from whence

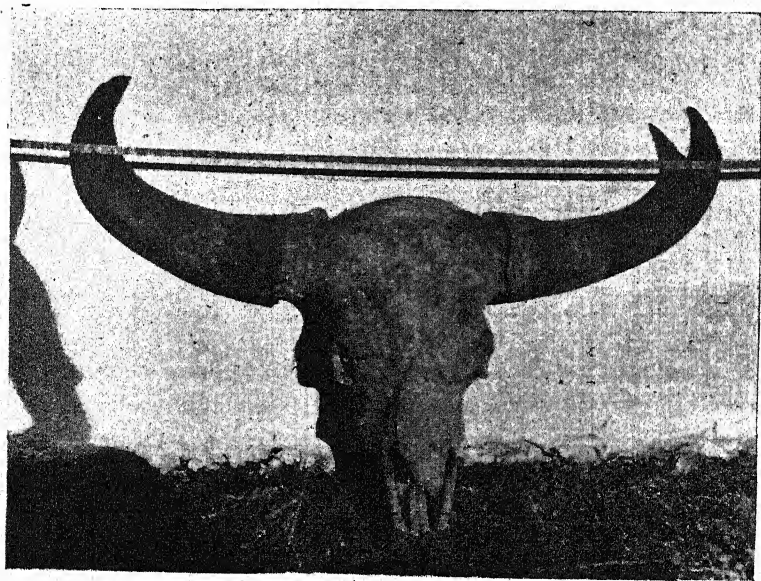
the sound was coming, and calling my Arab watchman I approached slowly for investigation. No sooner had the car-lights been focussed on to the hedge, a large frog (*Rana tigrina*) leaped out into the open, and immediately following it a small rat appeared and soon teeth fixed itself on the back of the frog. The rat had now fastened its teeth in the nape of its prey and there was the frog again emitting its pathetic cry. My Arab struck the rat with a stick as soon as it was separated from the frog, and the rat being killed, the frog leapt back into the hedge. On inspection I was surprised to identify the 'rat' to be a Musk-Shrew (*Suncus caeruleus*). I have never even seen a common rat attacking a frog much less a 'Muck-rat'.

BHAVNAGAR,  
13th October 1945.

K. S. DHARMAKUMARSINHJI.

#### 6.—A LARGE GAUR HEAD.

(With a photo)



A large gaur head.

We enclose a photograph of a Gaur Head (*Bibos gaurus*) shot by H. H. the Raja Saheb of Korea State, Central India and feel sure it will be of interest to your readers.

Greatest width 45"

Length from tip to tip 72"

Left horn 28"

Right horn 27½"

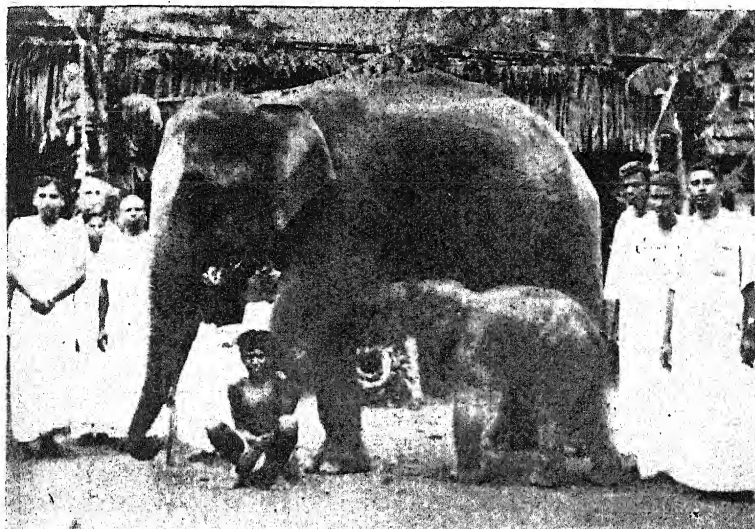
Circumference at base of horns 17½".

MYSORE S.I.,  
19th December 1945.

VAN INGEN & VAN INGEN.

# 7.—PERIOD OF GESTATION OF THE INDIAN ELEPHANT (*ELEPHAS MAXIMUS*).

(With a photo).



Indian Elephant with newly born calf.

An interesting elephantine romance was brought to my notice by Mr. A. S. M. Nair, Commissioner, Hindu Religious Endowments Board, Madras. According to the very reliable reports he had obtained, a female elephant belonging to the Sri Emuri Bhagavati Temple, at Kallekulangara, near Palghat, in the Malabar District, was covered by a wild tusker, on or about the 19th November, 1938. The tusker came probably from the outskirts of the Olavakkot forest to the place where the cow elephant was tethered. The tusker remained with the cow elephant for three days, and the courtship and mating were watched by the inhabitants of the locality. The report that the tusker did not eat a morsel of food during the three days has not been verified by me. Efforts made to capture it by doping seem to have failed because of the tusker's extreme wariness. The tame female elephant calved on Friday 6th September 1940—this date was noted by the Manager of the temple, Mr. E. Chathu Achan, of Akathethara village—and the baby tusker, now about five years old, is said to be thriving. In the photograph reproduced here (which was very kindly lent to me by Mr. Nair), the baby elephant can be seen sucking its mother's milk.

The period of gestation in this case is about 21 months and 18 days. In the case of a male calf reported by Corse (*Tr. Roy. Soc.* 1799) it was 20 months and 18 days.

I was informed by the Manager of the temple that in August 1945, the same wild tusker came again to the old spot to meet the female elephant, and this time it was driven away with the



greatest difficulty. The people of Malabar are so elephant-minded that reliance can be placed on their identification of the tusker as the one they knew in 1938.

GOVT. MUSEUM,

EGMORE, MADRAS,

A. AIYAPPAN.

20th November. 1945.

#### 8.—BIRTH OF AN ELEPHANT CALF.

Reading in the Miscellaneous notes of the *Journal* of the B.N.H. Society, on page 183 of Volume xxxviii, of the birth of an elephant calf on the bank of the Menik Ganga in Ceylon, brought to my mind an experience of my own on X'mas day 1903 in the Anamalai Hills, near Coimbatore. On that day, about 9 in the morning, the late Mr. G. A. Marsh and I went to visit a small plantation of bananas, on the Paralai Estate, which had been damaged by elephants. Hearing a herd of elephants a considerable distance away in the jungle making a tremendous amount of noise, much more than usual,—trumpetting, squealing, breaking of branches etc., we decided to investigate, and proceeding towards the herd, which could not be seen owing to the extremely dense jungle, we soon found a wild fig tree, very easy to climb, on one of the branches of which, about 25 feet above the ground, we perched ourselves. Shortly after this, three female elephants came up to our tree, and one of them entered a cane brake, (*Eeta*) right under the branch on which we were sitting. The other two remained outside the clump of *Eeta*, apparently keeping guard, for on the approach of other members of the herd, (it was a fair sized herd of about 30 animals we thought) they were definitely warded off. After a time—about half an hour—the two guards went away, but we could not descend from our tree because we knew the third elephant was still in the cane below us. We were very mystified as we could not even guess at what was happening. We waited there for a full hour, at the end of which the third elephant emerged, went a few steps, put its trunk to the ground and made that peculiar drumming noise, one so frequently hears an elephant make. At once a very small calf came out from the cane, and went with slow steps towards its mother. It was wet and shiny, but not very dark skinned. It was suckled for a short while, when the mother moved on towards the direction of the herd which was by then a quarter to half a mile away, still making much more noise than usual.

When we considered it safe to do so, and the mother and calf had disappeared, we descended from the tree and inspected the cane brake. We found the placenta there—a very pale pink, and weighing, we judged, about 10 lbs. This placenta looked rather like pale raw liver. There were two or three very much thickened portions, roundish in shape, about 3 inches in diameter which we judged might have been the attachment of the placenta to the body of the mother. These thicker portions were between  $\frac{1}{2}$  to  $\frac{3}{4}$  of an inch thick, but the rest of the placenta was much thinner—not more than  $\frac{1}{16}$ th to  $\frac{1}{8}$ th of an inch.



By this time it was noon and we went home. We had no weapons with us. Unfortunately the cane brake was so thick that we could not see the actual birth of the calf, and so are unable to state whether it was delivered by the mother standing, or lying down, but judging from the marks we saw, we thought the mother must have been kneeling. So far as we could guess, the calf when it came out of the cane was about the size of a half grown wild pig.

I am afraid these notes do not add much if anything to our knowledge of the subject, but they may be interesting to some members.

28, LALBACH ROAD,  
BANGALORE,  
9th October 1945.

J. R. VINCENT.

9.—THE ASHY SWALLOW-SHRIKE (*ARTAMUS FUSCUS*)  
IN THE NILGIRIS.

On April 26th 1944, I watched a pair of the Ashy Swallow Shrike (*Artamus fuscus*) at Kotagiri in the Nilgiri Hills and at an elevation of 6,300 ft. They were on a dead Eucalyptus tree and may well have been breeding, since they were very pugnacious, driving off crows and kites which came near. I put this on record as this species does not seem to have been recorded much above 5,000 ft.

2, ASSAM REGT.,  
11, A. B. P. O.,  
November 1945.

C. R. STONOR,  
Major.

10.—OCCURRENCE OF THE WHITE-BELLIED OR SNOW  
PIGEON (*COLUMBA LEUCONOTA LEUCONOTA*) AT A LOW  
LEVEL IN THE KUMAON HIMALAYA.

Early in January 1945, there was an unusually heavy snowfall in the Kumaon and Garhwal Himalaya in the United Provinces, snow incidentally falling in Dehra Dun at 2,000 feet and down to as low as 1,600 feet in some of the deep valleys of the outer hills. Later that month I was touring in the eastern part of Almora District, and on January 30th I was in the Sarju valley near Nali forest rest house (about half way between Rameshwar and Bageshwar), where the river runs at about 2,200 feet and the road is some hundreds of feet above the river. Here I came across a flock of 8 snow pigeon (*Columba leuconota leuconota*) feeding on a grass slope between the road and the river. Snow had by then melted in most places below about 6,000 feet. I have often seen and shot this species at high levels near the snow peaks between about 10,000 and 13,000 feet, and the distinctive grey, white and black plumage was unmistakable even at some distance. But I shot 4 of them and made certain by a reference to the Fauna of British India that my identification was correct.

I have toured for many years both in summer and winter throughout the U.P. Himalaya and I cannot remember ever seeing this snow pigeon except at high levels near the main snow range, and certainly not much below 9,000 feet or more than 5 to 10 miles from the permanent snow level. But here was a flock at an elevation of less than 2,500 feet and 35 miles in a direct line from the nearest permanent snow. It is probable that the exceptional snowfall earlier in the month had driven them to lower levels, but I feel that this occurrence at such a low elevation and so far from their usual habitat is worth recording. The habitat given in the Fauna of British India is 'between 10,000 and 12,000 feet and less often a thousand feet higher or lower', which agrees with my usual experience, and the lowest occurrences mentioned are 5,000 feet in Chitral and 7,000 feet in Kashmir.

NAINI TAL,  
U.P.,

2nd November 1945.

D. DAVIS, I.F.S.,  
Conservator of Forests.

11.—MIGRATION OF THE MALLARD (*ANAS*  
*PLATYRYNCHA*): RECOVERY OF RINGED BIRD.

A Mallard (*A. platyryncha*) was shot at Sakrand Lake, Nawabshah, Sind, on the 14th January 1945, bearing one of the rings of the Bird Banding Bureau, Moscow. The incident and description of the ring and serial number was sent to the society by Mr. Hardit Singh, Inspector of Agriculture, Nawabshah Sind. Subsequent correspondence with the Director of the Russian Bureau, elicited the information that the Mallard was ringed 'as a moulting bird at the Astrakhan State Reserve, near Astrakhan, delta of the Volga River'. The date of ringing was not specified.

EDITORS.

12.—OCCURRENCE OF THE PINK-FOOTED GOOSE  
(*ANSER FABALIS BRACHYRHYNCHUS BAILLON*) IN  
INDIA: AN AUTHENTIC RECORD.

I am sending the skin of a goose shot by His Highness today in Bikaner. It has not been possible for us to identify it. Will you kindly therefore examine the skin very carefully and let me have your opinion for His Highness' information as to what species of goose it is.

It is possible that it may be a hybrid. On the other hand it is also possible that it may be a young Dwarf Goose. But in the plate given in Hume and Marshall's book opposite page 77 there appears to be no black tip to the beak which this bird has. On the other hand the beak in the plate is yellowish in colour, whereas in the bird it is pinkish.

The black wing and tail feathers seem to tally more with the Dwarf Goose than any other. It also has yellow legs. On the whole it appeared to be a bird not bigger than a Barr-headed Goose, and if anything slightly smaller.

Thanking you for the favour of an early reply.

LALLGARH, BIKANER,  
RAJPUTANA,

PRIVATE SECRETARY TO  
H.H. THE MAHARAJA OF BIKANER.

1st December 1945.

[On examination of the above-mentioned specimen considerable difficulty was experienced in establishing its true identity as the colouring of the soft parts described by E. C. Stuart Baker (F.B.I., Vol. 6, p. 402) applies to the typical race *A. f. fabalis*. At the same time under the heading of 'Habits', he writes, 'Records of the occurrence of this goose (*Anser brachyrhynchus*) in India are comparatively numerous but there can be little doubt that the great majority of these refer to the next bird *Anser neglectus* or, perhaps, to some other Bean-Goose. In 1849, Blyth recorded the Pink-footed Goose in the Punjab; in 1864 Hume shot two specimens believed to have been this species in the Jumna, and Irby records one having been killed near Lucknow in 1858. In 1879 Hume again recorded it. General McLeod says that in 1853 he shot one near Gurdaspur in the Punjab. The only record, however, which applies without doubt to the Pink-footed Goose is that of the one shot by one of my collectors in the Sarma Valley, Assam. The smaller bill of this specimen, 40.60 mm.,<sup>1</sup> alone is sufficient to show that it was not one of the bigger Bean-Geese. The small bill of *A. f. brachyrhynchus* certainly appears to form a good distinction between it and the larger bill of *A. neglectus*, Sushkin's Goose (culmen 55-63 mm.) which resembles it in plumage'.

However, C. B. Ticehurst, commenting in the *Journal* on the *Fauna of British India: Birds* (Vol. 34, p. 489) doubts Baker's Assam record. He opens his notes on *A. brachyrhynchus* with a question. His remarks are as follows:—

'Is there any specimen of this goose from India in existence? If not, it should be deleted from the *Fauna*. The Pink-footed Goose is a bird of rather limited and distinctly westerly distribution in winter at which season, according to Buturlin, there is not a single record so far east even as European Russia. What the Goose obtained in Assam was with a bill of 40.6 mm. I cannot say; this is too small a bill for the Pink-footed Goose, 15 of which in my collection measure 43-50 mm.'

Perhaps the last word on the subject is to be found in the *Handbook of British Birds*, Vol. III and we can do no better than reproduce the passages dealing with the essential details of both the typical race, *A. fabalis fabalis* and *A. f. brachyrhynchus*, the sub-species with which we are concerned:

<sup>1</sup> Probably a misprint for 46 mm.

*Anser fabalis fabalis* (Lath.).

Measurements: '♂ wing 447-498, mm. tail 117-145, tarsus 71-87, bill from feathers 56-66, . . . . ♀ wing 424-452, bill 51-60, l.c. p. 196.

Distribution: 'Typical race passes through Europe to winter in Mediterranean (rarely N. Africa), Black and Caspian Seas; also Asia Minor, Palestine, Persia to Turkestan. Eastern races winter in N. China and Japan. Casual in Madeira and Egypt.'

*Anser fabalis brachyrhynchus*:

Measurements: '♂ 417-490 mm., tarsus 69-83, bill from feathers 41-54 (36 measured). ♀ wing 395-454, bill 37-48 (32 measured.)' Tail 16-18 feathers.

Colouring of soft parts: 'Legs and feet (ad.) flesh-pink to bright pink (sometimes almost purple. Caton-Haigh), (juv.) on first arrival (Sept.) usually pale pink or dull reddish-grey but many are yellow ochre or ochreous—flesh gradually changing to pink during first winter (Coombes);' l.c. p. 200.

Distribution: Breeds only in N. E. Greenland, Iceland and Spitsbergen. Winters in France (rare) Belgium, Holland, Germany, and occurs (or on passage) Jan Mayen, in Faeroes, Bear Island and Scandinavia. Accidental in Switzerland, Austria, Italy, Cz.-Slovakia, Baltic States, Hungary, Y. Slavia, Roumania, N.W. & S. Russia. Once U.S.A.

Very possibly the specimen referred to by Baker has not been preserved or, if preserved, mislaid. As he gives the measurement of the bill (40.6 mm.) he must have handled the specimen himself. Being a competent ornithologist, Baker must have known the species he was handling at the time. Baker's measurement falls well within the range recorded in the *Handbook of British Birds* for *brachyrhynchus* females, and even the slight difference of under 4 mm. is really negligible considering that the method of measurement may vary with individuals.

The measurements of the bird sent to us from Bikaner are: wing 395 mm., tarsus 82 mm., bill from feathers 46 mm., tail 135 (18 feathers), nail 12 mm. All the measurements suggest that this bird is a female of the species *A. f. brachyrhynchus*. Eds.]

### 13.—SOME COMMON BIRDS OF KATHIAWAR—ABSENT OR RARE IN KUTCH.

Mr. Sálím Ali's 'Birds of Kutch' has shed a valuable flood of light on the bird life of that area and in the side-light I cannot help comparing the bird-life of my province, Kathiawar.

The learned author has pointed out that the Great Rann is an effective barrier to the local movement of birds in Kutch. It would be interesting to know to what extent, if any, the Little Rann presents such a barrier. I am inclined to think that there might be a free seasonal movement of birds to and from the adjacent areas of North Gujarat and Kathiawar over the Little Rann: If that is true, I wonder why some of the common birds of Kathiawar are absent or rare in Kutch, while others are as common

in Kathiawar as in Kutch. This appears to be strange when we view it against the background of physiographical, climatic and floral conditions, which are almost identical in Kutch, Kathiawar and N. Gujarat. We are told that the resident birds of Kutch, as also the local migrants, approximate more closely to the birds of Gujarat and Kathiawar. There seems to be no reason, therefore, to justify the absence of such common birds as the Jungle-crow, the Tree-pie and the Crow-pheasant from Kutch. This question may take us to the origin of species of birds in Kutch and if Mr. Sálím Ali will throw more light on the question I should not be disappointed in expecting very valuable and interesting information.

Giving some specific instances, I wonder what prompted the Jungle-crow to make a 'peaceful penetration' into Kutch recently where it was absent so long. The Tree-pie is not rare in afforested areas and gardens in the three adjacent provinces. During my flying visit to Kutch a couple of years ago I saw beautiful gardens and 'wādis' near Mandvi and Bhuj, but I cannot imagine why they have not attracted the Tree-pie.

The Jungle babbler presents a different problem, as also the Rosy Pelican. If the former once flourished in Kutch it is difficult to know the reason why it left the benevolent protection of the bird-loving rulers of Kutch. Mr. Sálím Ali observed the Pelican at Mithapur in N.W. Kathiawar, but not in Kutch where it was observed by Lester in 1893. The bird is a common winter visitor to the backwaters of the west coast of Kathiawar, and on my way to Kutch I saw a party on the Miani creek about half way between Mithapur and Porbander. When I was stationed at Navibunder, some distance south of Porbander, I observed that the Pelican was the earliest bird to arrive there on the tidal waters of the mouth of the Bhadar, the biggest river of Kathiawar. A party of about 50 birds arrived there in the last week of August and disappeared next day, leaving a few to spend the cold weather there. One of them tried to swallow a fish too big even for its bulky bill and pouch and the misadventure cost the greedy bird its life. I wonder why the Pelican, on its way to Kathiawar, should rule out the creeks of Kutch.

Mr. Sálím Ali informs us that the Coucal or Crow-pheasant was recently introduced into Kutch from Jamnagar under the name of 'Jamnagar crow'. I have observed in Kathiawar that the Coucal inhabits even distant and isolated gardens in barren tracts. In fact it is so well known there that it has its local name which appears to have been adopted in English. Another remarkable absentee is the Magpie Robin, which Kutch is unlucky to miss in spite of localities quite suitable to this pretty bird. Barring some semi-desert regions in Kathiawar, every garden there claims the patronage of this beautiful songster.

As in Kutch so also in Kathiawar, the Paradise Flycatcher is a rare straggling passage migrant and I have seen only one specimen in a garden in the heart of Porbander.

The distribution of the Bank Myna is remarkable. While it is uncommon and patchy in Kutch, it is more common than the Common

Myna in Gujarat, tolerably common in E. Kathiawar and only a winter visitor in W. Kathiawar. The Pied Crested Cuckoo, though fairly common in Kutch, is unknown in Kathiawar except some well shaded areas near Bhavanagar and, probably, Junagadh. On the other hand, while the Coppersmith is a *rara avis* in Kutch I cannot imagine a *Ficus* tree in Kathiawar not visited by this ventriloquist.

Besides the Pelican, I must arraign the White Stork for shunning the domains of the Maharao and selecting the scanty marshes of Kathiawar, where not many rulers have the love for birds at their heart. While travelling from Jamnagar to Ahmedabad I saw a flock of white storks in the month of May! Again, while taking a morning walk to observe bird-life at Than in N. E. Kathiawar I saw a party of white Storks busy with their morning breakfast. This was in September.

Want of space forbids me to prolong these notes, but I cannot close these lines without stressing the importance of the west coast of Kathiawar in relation to the migration of birds for many of which it is a passage route. With thrill and delight I remember the days of my boyhood when we enjoyed the pleasure of observing these annual migrations. Birds flew over even at night, and while the sonorous and shrill trumpetings of cranes, resounded in the cool air, we craned our necks in vain to pick up a glimpse of the birds against the canopy of the starspangled sky. It is important to note that I have never seen their return flights in spring. This shows that, as in Kutch so also in Kathiawar they take a different route on their return home.

Let me hope that one day some enthusiastic ornithologist like Mr. Salim Ali will get an opportunity to survey the avifauna of my Province and give us surprising and interesting wealth of information.

ANDHERI,

11th January 1946.

V. M. VASU,

Advocate.

#### 14.—'BIRDS OF VIZAGAPATAM DISTRICT'—SOME NOTABLE OMISSIONS.

The contribution to the September issue of the Society's *Journal* by Mr. Humayun Abdulali on the birds of Vizagapatam District (Vol. 45, p. 333) has filled a notable gap in the ornithological records of India. It is indeed surprising that in spite of the Vernay Survey there should have hitherto been such sparse records of the bird life of this large and important district. The Vernay Survey for instance reported that there was no record of three very common birds, the Green Bee-eater, the Pied King-fisher and the Blue Jay, in the Madras Presidency north of the Godavari. All three of these birds can be seen in considerable numbers from the windows of the Madras-Calcutta mail as it passes through the Vizagapatam District. I worked in the Vizagapatam District for

two or three years, and from my observation there would say that the Pied King-fisher and the Blue Jay are more common there than in any other district of the Presidency. There are two items of information I should like to add to Mr. Abdulali's article. The Grey Hornbill is not uncommon in the plains of the district, and I remember to have seen it frequently near Palkonda, in particular. Also I saw a pair of Great Hornbills in dense jungle near Lotugedda in the Agency tracts in September 1930. Although I read in a back number of the *Journal* (xxxvii No. 4) that there was no record of these birds being found on the eastern side of the Madras Presidency, I can positively assert that I was not mistaken.

The notes of Mr. La Personne on the birds of Salem district in the Vernay Survey are very complete. But I am sure much valuable information could be gathered if an expert paid a winter visit to the district. Throughout the cold weather a blue rock-thrush is to be seen at or about the same point on the ghat road to Yercaud, some 3,500 feet above sea-level. It disappears about the end of April, and this year I saw it again on the 1st October. On the 8th October last year a pair of Black Redstarts appeared in my garden. They were gone the next day, and I have not seen the bird this year. The Blue-tailed Bee-eater puts in an appearance in large numbers with the north-east monsoon. This year the first arrivals were noticed on 6th October. The Green Bee-eater is of course numerous throughout the year, but the Chestnut-headed Bee-eater seems to be rather commoner in summer than in the winter or the rains. It is perhaps worth noting that the Brahminy Myna is extremely common in and around Salem, whereas during a stay of a year and a half in the adjacent district of Coimbatore I never saw a single specimen. In December last year a wedge of a dozen or more wild geese was seen flying southwards over the middle of Salem town. The Vernay Survey expresses some doubt regarding the occurrence of the Common River Tern in Madras. Terns (presumably belonging to this species) can be seen in fairly large numbers—together with cormorants and one or two herons—on the Cauvery river at Hogainakal. There are also terns and cormorants below the Mettur dam on this river.

Even in my own compound of some half a dozen acres the variety of birds that can be seen is quite remarkable. For example I may mention that Ashy Swallow-shrikes perch every evening, huddled close together, on the wireless aerial. The Wood-shrike's distinctive call can be heard almost daily. The Bay-backed Shrike, the Black-headed Cuckoo-shrike, the large Cuckoo-shrike, and the great Grey Shrike all visit the compound, some of them frequently.

I should be very glad to offer hospitality to any observer whom the Society might depute to pay a visit to Salem.

COLLECTOR'S BUNGALOW,

SALEM,

R. C. BELL, I.C.S.

6th November 1945.



## 15.—THE BIRDS OF BURMA.

[A reply to Major B. E. Smythies' note (Vol. 45, p. 448).]

May I reply briefly to Major B. E. Smythies' courteous criticism of my monograph on the vegetation of North Burma in the September *Journal*.

In the first place I did him less than justice both in my remark that he had not visualised North Burma, and in my suggestion that he had underrated the avifauna of that region. The former error is perhaps pardonable as I believe Smythies' journeys (worthy of a pioneer explorer) were actually made after the publication of the *Birds of Burma* and I did not fully appreciate his geographical sense. My excuse for the latter must be his own modesty in disclaiming any credit for his book. I have since learnt that a large share of the credit is due to him, and from letters I have received from him, as well as from his published work I have come to realise how comprehensive his knowledge of Burmese birds is, how accurate his observations and how authentic his statements.

He says that North Burma is poor in birds, and I am bound to accept that. At certain seasons however, as he himself is willing to concede, there may be a flush of birds—though he appears sceptical of my procession. Though I am loath to withdraw my wager that there might be 50 species and/or varieties new to Burma in the far north, I feel now that it was a rash bet. Might I however suggest that some of them are likely to be found amongst the wrens, chats, warblers, fly-catchers, bulbuls, babblers and other small birds. He must not however expect me to name them—if I did, they would not be new!

On one point however I must disagree with Smythies. I am indeed rather surprised that a field naturalist of his calibre should think that birds, many of which eat seeds and are responsible for distributing plants in a variety of ways, are not the concern of the botanist. The fact that I am ignorant about them does not alter the fact that it is desirable to learn.

When Lord Cranbrook spent a season with me in the Adung Valley, I collected 30% of the birds myself and made some observations, though I never got any credit for this. Now I know why. I am a botanist. . . . It was when Cranbrook and I were camped on the bank of the Adung at the last Tibetan village (6,000 feet) from February to May, that we made the bulk of our collection and I noted the 'vast procession of migratory birds'. The low level *Rhododendrons* were in bloom, I think Cranbrook would concur. We added several birds to the Burma list, though we could not have collected a tithe of those we saw,—nor skinned a tithe of those we might have collected. And this in one short season, in one small valley. Multiply our efforts by 10, by 20, and we might conceivably begin to approach my figure. As for the 'few passing kicks' which Smythies in lighter vein says that I handed out (can one hand out a kick?) to the *Birds of Burma*, these were aimed at the map only; and after all a friendly kick is not far removed



from a kiss! I have spent many happy hours on some of the remoter rivers of Assam watching birds with the *Birds of Burma* open beside me. Unfortunately it was not mine and I returned it reluctantly to its trustful owner, having overcome a great temptation.

Smythies' has written me that his book may be republished. I sincerely hope this is true.

KHOWANG TEA ESTATE,

MORAN DISTRICT,

UPPER ASSAM.

F. KINGDON-WARD.

16 September 1945.

16.—ON THE BREEDING OF THE TIGER SHARK  
(*GALEOCERDO TIGRINUS* MULLER & HENLE).

The systematics of the Tiger Shark *Galeocerdo tigrinus* was included by me in a previous paper published in this *Journal* (Vol. xlv, No. 1, 1943). The paper also contained an account of its feeding and breeding habits, based on the observations from such stages of pregnancy as were then available to me. Subsequently I conducted an autopsy on a female with young in her uteri, almost ready for expulsion. The condition observed is described below:—

*Parturition stage* :—

Parent female: total length 12' 11"; app. wt. 1,500 lbs.; date 4-5-43.

Each uterus had 13 foetuses, 7 males and 19 females. They were enclosed in water-filled sacs and floated freely in them, there being no attachment to the uterine wall. The foetuses ranged from 2' 3" to 2' 5½" in total length. Their yoke-sacs and umbilical cords were extremely reduced in size and length and showed conspicuous structural degeneration. There was no longer any yolk in the yolk-sacs, and their walls were extremely shrivelled up without any trace of blood capillaries. The reduced umbilical cords measured from 2" to 4". The umbilical vessels had atrophied and fibrosed. The umbilical sheaths showed considerable rugosity and fibrosis near the points of attachments, suggesting that they would shortly be cast off. A dissection of the foetus revealed the presence of a large internal yolk-sac containing plenty of yellow yolk. All these features made it evident that parturition was near at hand. The mucous membrane of each of the uterine compartments (horizontally disposed) was plain and smooth but fairly vascular.

These observations clearly verify the inferences drawn by me in my aforesaid paper that,

1. The young of this species measure, at birth, about 2' 6" in length, and

2. That *G. tigrinus* is a non-placental form. The large quantity of yolk in the sac serves as nourishment for the embryo throughout its intra-uterine life, no placenta being at all formed.

DEPARTMENT OF FISHERIES,  
BOMBAY,  
30th October 1945.

P. N. SARANGDHAR, M.SC., PH.D.

# 17.—A NOTE ON THE CONSERVATION OF OUR INLAND FISHERIES BY LEGISLATION.

An enquiry was made by Francis Day<sup>1</sup> in 1868-70 into Fresh water Fisheries of India and Burma showed that an indiscriminate and wholesale slaughter of fish life took place annually. Dr. Day pointed out that unless remedial measures were adopted this indiscriminate destruction of spawners and spawn would result in great diminution in the fish supply of India.

*Legislation.*—It was, however, in 1897 that protection to Fisheries in India was afforded by legislation with the enactment of Indian Fisheries Act IV. This Act, as Comber<sup>2</sup> (1906) pointed out was very far from being what all competent experts would have liked to see it. It prohibited the use of poisons and dynamite in rivers, but practically left everything else to local administrations to whom power was given to frame such minor rules, under the Act, as might seem necessary for the protection of fish in waters under their jurisdiction—by prohibiting or regulating (a) the erection and use of fixed engines, (b) the construction of weirs, and (c) the dimension and kind of nets to be used, and the modes of using them. No machinery was introduced for the proper working of the Act.

*Provincial legislation.*—Inquiries recently made show that in some provinces the Indian Fisheries Act has not been adopted at all, in others it is in force but no subsidiary rules have been drawn up. In Bengal, owing to Permanent Settlement, the fisheries position is very complicated. Some protection to fisheries in reserved and protected forests is afforded under the Forest Act. In respect of private waters, Private Fisheries Protection Act, II of 1899, passed by the Bengal Legislature penalises poaching in such waters. In Bombay, fishing in the rivers is entirely free and no rules have been framed for conservation of inland fisheries. The same applies to almost all other provinces in India. It is only in the Punjab that the fisheries are protected by Provincial legislation. The Punjab Fisheries Act II enacted in 1914. Its provisions are applicable to all the rivers, canals and other public waters. The Act and the Rules notified thereunder prohibit (1) all kind of fishing in rivers

<sup>1</sup> Day, F. (1871)—'Report on the Fish and Fisheries of Fresh Waters of India and Burma. Simla. pp. 1-49.

<sup>2</sup> Comber, N. (1906)—'Protective Legislation for Indian Fisheries'. Journ. Bomb. Nat. Hist. Soc. XVII, pp. 637-644.

and canals except under a licence, (2) the use of small meshed nets and fixed engines, (3) sale of certain important species of fish caught in contravention of rules, and imposes (4) a close season for fishing during the breeding period of the fish.

Legislation, undoubtedly, prevents the depletion of the rivers by such harmful methods as small meshed nets, traps and fixed engines and thus helps in improving the fisheries. But the Indian Fisheries Act, IV of 1897, without any rules or without any machinery to work its provisions, is entirely inadequate to afford any substantial protection to the fisheries.

For the conservation of our existing fisheries, it is desired, that all Provincial Governments, where no rules or regulations for the protection of fisheries at present exist, may be advised to enact protective legislation and at the same time create an agency to work its provisions. The legislation should specially provide for the following:—

1. Control of all kinds of fishing under a licence.
2. Prohibition of small meshed nets, fixed engines, erection of dams and diversion of water for catching fish.
3. Imposition of a size limit below which no fish of such important species as Mahsir (*Barbus tor*), and others can be killed.
4. Provision of a close season during the breeding period of fish.
5. Prohibition of the sale of certain important species of fish caught in contravention of rules.

LAHORE,

7th July 1944.

HAMID KHAN, PH.D. (Cantab), F.A.S.C.,

Game Warden, Punjab.

#### 18.—ECOLOGICAL AND SPECIFIC VARIATION IN THE CAMOUFLAGE DEVICES OF SPIDER WEBS.

I am at present collecting records of orb webs with camouflage devices. Such spiders as the members of the Genus, *Argiope*, *Uloboridae* and *Cyclosa* are common through the tropics.

Hingston in his paper Devices of Spiders' snares (*P.Z.S.* 1927 Vol. xviii) gives an outline of the more common web designs, which is useful for reference.

The preparation of webs is quite easy. A sheet of white paper is covered with any good dilute gum, and then placed close to the web. The supports are then broken and the web and paper dried.

I process these webs with water colour to make the webs stand out.

The webs should be accompanied by the spider, in a small paper packet, and with notes on—

1. Where collected.
2. Whether grassy, or shrub ground, or in house, etc.
3. Some indication as to whether the web is exposed to direct sunlight and the amount of illumination.

The webs should be sent to my home address, as my army address is not very permanent. My address is as follows:—

35, HIGH PARK DRIVE,  
HEUTON, BRADFORD,  
YORKS, ENGLAND.

Any webs which you may send will be very acceptable and will help considerably in increasing the extent of my records.

S.E.A.C.,

J. E. MARSON, F.R.E.S.

11th October 1945.

19.—NOTES ON THE GIANT WOOD SPIDER (*NEPHILA*  
*MACULATA*) IN BURMA.

(With 2 plates).

*Nephila maculata* is very widely distributed in Burma. My own records for 1945 give the distribution as follows: 3-2-45 Maungdaw; 23-2-45 Ramree Island; 27-5-45 Taungup; 7-9-45 mile 35 Toungoo Mawchii Road; 14-9-45 mile 53 Toungoo Mawchii Road; 1-10-45 Mawchii.

The structure and method of spinning the web is very well described in Hingston's paper 'The Snare of the Giant Wood Spider'.<sup>1</sup> I would however like to add the following notes on the web.

It is very common to find that the female *Nephila* uses a maze of irregular webbing at one or both sides of the large orb web. Hingston comments on this point as follows<sup>2</sup>: 'There is another structure in the architecture of the *Nephila* which I have not observed in ordinary snares. Not only does she spread an extensive sheet, but she also constructs a special barrier in order to drive her victim more surely into the toils. She places it so as to face one surface of the sheet, it is at a slightly higher level than the main snare and a little distance away. There is nothing precise or geometrical in its workmanship, it is merely a tangled maze of lines.'

This addition of an irregular maze of webbing at one or both sides of an orb web is not uncommon amongst orb-web spinners, especially in the case of immature females, and with webs in shaded places. This is quite common with species of *Gasterocantha*, especially with *G. brevispina*. In these cases it is usual for the maze webbing to be dotted with patches of white webbing about a quarter of an inch long.

The structure of which Hingston says<sup>3</sup> 'she places it so as to face one surface of the sheet, it is at a slightly higher level than

<sup>1</sup> Hingston.—The Snare of Giant Wood Spider; *Journal of the Bombay Nat. Hist. Society*: Part I Volume xxxviii pages 642-649; Parts II & III Vol. xxviii pages 911-923; Part IV Volume xxix pages 70-75.

<sup>2</sup> As above.—Part III page 918, lines 18-31.

<sup>3</sup> As above.—Part III page 918, lines 21-22.

the main snare and a little distance from it,' is typical of the web of an adult female in a position where there is a fair amount of both room and light, e.g. between trees in fairly open woodlands. I found *N. maculata* amongst the well laid-out rubber plantations in Ceylon. This was the first time that I had met the species, and I cannot remember ever seeing any additional irregular webbing in these perfect conditions for spinning the large orb web. It is therefore probable that this irregular webbing is only added by an adult female when there are shrubs surrounding the web. The upper edge of this sheet of irregular webbing is attached to the upper supports of the orb web, the lower edge being attached slightly in front of the lower supports, giving a sheet of irregular webbing at an angle to the orb web.

It is very common to find wide variations from this form even in webs of adult females. When webs are spun in semi enclosed conditions, the addition of irregular webbing at both sides of the orb web is common, giving a much more impressive structure than that of the simple orb web. From a side view the web has the appearance of a spindle. In these cases the sheets of irregular webbing are supported at their centres giving a dome of irregular webbing, as illustrated by the heavy dotted line in Fig. 1, plate 1.

The following figures from a web of this type, spun in a rather limited space, will indicate the size of this additional webbing.

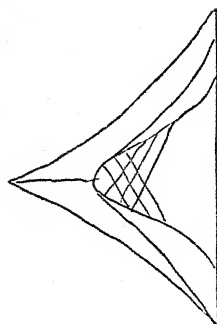
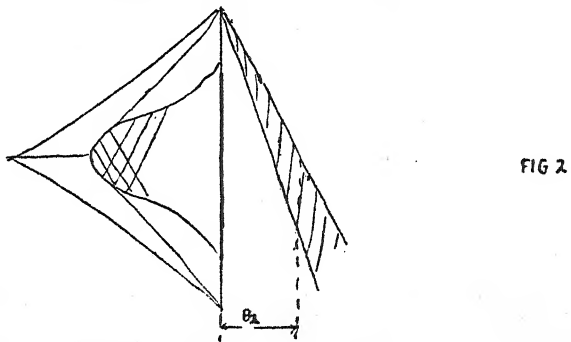
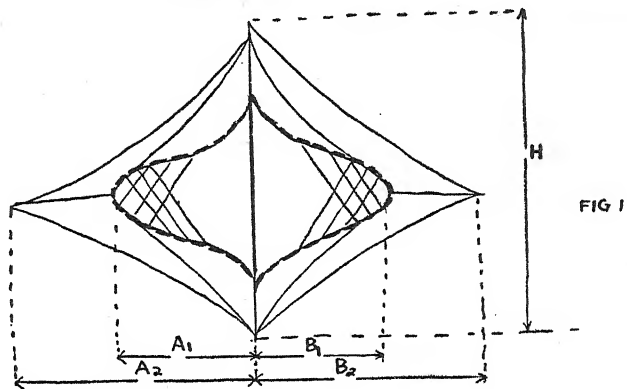
H 110 cms. A<sub>1</sub> 25 cms. A<sub>2</sub> 45 cms. B<sub>1</sub> 20 cms. B<sub>2</sub> 40 cms.

The actual form this webbing is very irregular as can be seen in Plate II where the irregular webbing has been superimposed upon the orb web as seen from a front view. These illustrations were drawn from webs prepared after the whole web had been completed for three days.

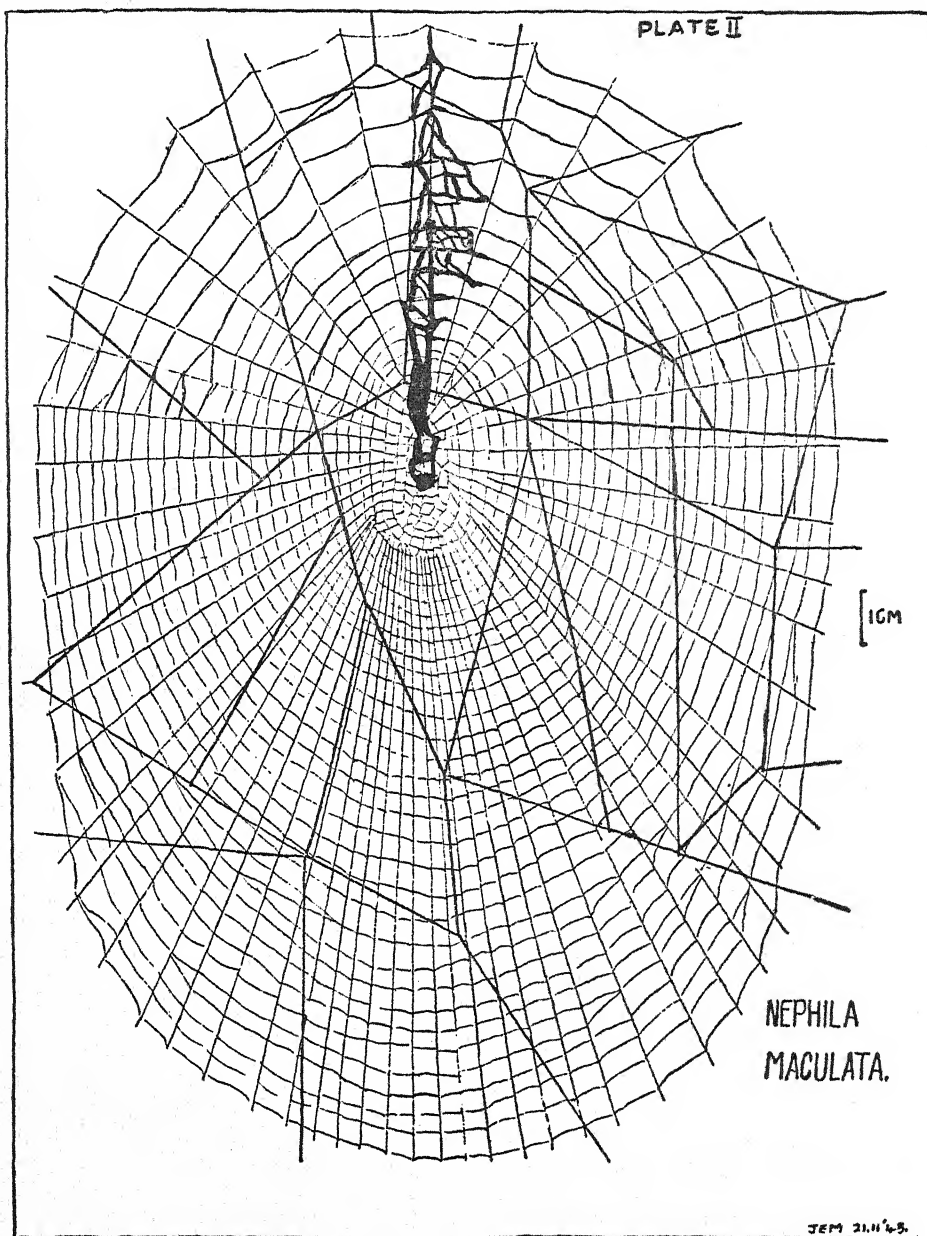
The completest form of this irregular webbing is however best seen in the young stages of the female. I have never found the younger stages without an irregular web at both sides of the orb web. Often these are large as compared with the height of the orb web supports, the complete width of the spindle being equal to the height of these supports.

Abdomen Length	Orb Web Height 'H'	Measurements of Spindle				
		A <sub>1</sub>	A <sub>2</sub>	B <sub>1</sub>	B <sub>2</sub>	A <sub>2</sub> + B <sub>2</sub>
1.1 cms.	50 cms.	10 cms.	20 cms.	7 cms.	25 cms.	45 cms.
1.1 "	50 "	12 "	28 "	9 "	25 "	53 "
1.2 "	45 "	13 "	20 "	...	8 "	21 "
1.4 "	75 "	18 "	40 "	...	15 "	33 "
1.6 "	80 "	15 "	25 "	...	10 "	25 "

PLATE I



NEPHILA  
MACULATA  
WEB TYPES.



With older stages, it is usual to find an irregular cone web at the most shaded side, and the orb web and a sloping sheet of angular webbing at the other side. In this cone the width of the additional webbing is about half the height of the orb web, Fig. 2, Plate I. Webs of almost mature females usually have the irregular webbing at one side, the shaded side of the orb web, Fig. 3, Plate I.

I have only recently started recording measurements of these webs but the first set of measurements indicate that the extent of this additional irregular webbing is determined by the maturity of the female and the intensity of illumination.

It is common to find immature male spiders in the webs of immature females, but in this case they are always found resting in the irregular webbing. They only move to the side of the female's orb web when they both reach maturity.

It is quite common to find that insects have become entangled in the irregular webbing and have not been touched by the female; so it is probable that the use of this maze of webbing is to prevent the spider being plucked from its web by animals which prey on the younger stages. Only insects caught in the central orb are used as food.

In webs of immature females, a vertical line of heavy white webbing about three-eighth of an inch wide and half the height of the orb web is often introduced. This has a camouflage effect similar to the confusion effect of the concrete zigzag of *Argiope*<sup>1</sup>. At times this line of heavy webbing is also present in the adult female's web, Plate II. The webbing of the immature female is white but that of adult is yellow. There is no form in the arrangement of this additional webbing and it may be composed of the remains of parts of the web, which the female has broken down and failed to digest<sup>2</sup>. With this additional webbing being yellow in colour, the abdomen of the female merges with it, the large spider's outline being very confused.

MAWCHII, BURMA,  
30th November 1945.

J. E. MARSON,  
F.R.E.S.

#### 20.—THE BUTTERFLIES OF THE NILGIRIS— A SUPPLEMENTARY NOTE.

I should like to make one or two comments on Mr. Wynter-Blyth's excellent article, 'The Butterflies of the Nilgiris, Part I', published in Vol. xlv, No. 4 of the *Journal*.

<sup>1</sup> As above.—Part III pages 918-919, lines 50-51, 1-50.

<sup>2</sup> Hingston.—Devices in Spider's Snares; P.Z.S. 1921, Vol. xviii, pages 283-285.



1. *Pathysa antiophates naira*, M. In Vol. xxxviii, No. 4, Brigadier T. E. Delves Broughton reported that he had in his collection two specimens, taken on the Nadghani Ghat Road on 23-4-1921. The butterfly can definitely be included in the Nilgiri list.

2. *Prioneris sita*, Fd. The British Museum has this butterfly from the Nilgiris, from Crowley's collection (*Vide* my list in the *Journal*, Vol. xxxviii, No. 2).

3. *Discophora lepida lepida*, M. This is listed by Hampson: 'one female seen on the Western Slopes in October 1888 at 300 feet'.

4. *Euthalia nais*, Forester.; *Euthalia lepida miyana*, Fruh., *Euthalia garuda meridionalis*, Fruh., *Euthalia lubentina arasada*, Fruh., *Euthalia evelina laudabilis*, Swin:—All five, not merely *nais*, are recorded by Hampson as Nos. 71-75 in his list of 1888. Of *nais* he says, 'In bamboo jungles'. Of the other four he says, 'Rare', and of *evelina*, 'Rare and difficult to catch'. He records the heights between which he took them.

By a slip of the pen Mr. Wynter-Blyth says, '*evelina* and *garuda* seem to be common round Bangalore.' I never heard of *evelina* being caught or seen round Bangalore; perhaps my information is incomplete. It certainly is not common in that neighbourhood, if at all it exists. '*Evelina*' is, I think, wholly an evergreen forest butterfly. The two species common round Bangalore are *nais* and *garuda*; the latter is very common among the mango trees.

5. *Doleschallia bisaltide malabarica*, Fruh., has been taken in the Nilgiris. The record of one taken by Stokes Roberts was given me by the British Museum; whereabouts, I do not know. (*Vide* my list in Vol. xxxviii, No. 2 of the *Journal*.)

CRANHAM,

• BERKHAMSTED,

J. A. YATES.

16th December 1944.

## 21.—NOTE ON THE BUTTERFLY, *MELANITIS* *PHEDIMA VARAHA*.

Mr. Wynter-Blyth's note on this insect, in Vol. xlv, No. 4 of the *Journal* has induced me to offer a few observations.

(1) This butterfly is common in Coorg. It appears to favour the evergreen area or the mixed evergreen and deciduous areas. And, as evergreen and mixed forest or woodland, cover the greater part of the province, it is almost ubiquitous. Specimens in my collection—a selection of catches—range in altitude from the foot of the Ghats upwards, and in extent from Urti in the south to Somwarpet in the north, i.e. from 300 feet above sea level to 3,700 feet.

(2) The dry season forms appear, it would seem, early in November and persist until early May. As to the wet season forms, I find that I took them September-October. I was never in Coorg during the heavy monsoon months, June to August; I think it very probable that the wet season forms last from June to October. My collection covers the months September to May.

(3) D.S.F. are generally quite a bit larger than W.S.F.

(4) W.S.F. ♂♂ *Above* dark. *f.w.* not produced, and termen not angled, or only vestigially angled. Black spots not visible; and no white spots on *f.w.* or *h.w.*

*Underside*, as described by Evans. 'Ocelli small, but more or less complete and usually well formed. (This applies also to ♀♀). But there is great variation. In some specimens the ocelli are very small; white centre hardly visible. Or, the *h.w.* ocelli are clear but *f.w.* Ocelli faint. The discal line, however, is generally clear.

W.S.F. ♀♀. Lighter in colour, brown not blackish. *f.w.* slightly produced and angled. 'Tail' at v. 3 *h.w.* slightly longer than that of ♂ W.S.F. White spots variable, 2, 1 or 0.

(5) D.S.F. ♂♂. *Above* dark brown, ashy on margin. Sometimes on *f.w.* angle and *h.w.* 'tail' slightly ferruginous. Dark spots on *f.w.* visible, but not prominent. White spots *f.w.* generally present, 1 or 2, but occasionally 0. Sometimes minute white spot on *h.w.* near v. 2 towards margin.

D.S.F. ♀♀. *Above f.w.* more produced and angled than W.S.F. Spots on *f.w.* variable as in W.S.F. *h.w.* 'tail' v. 3 longer than in W.S.F.

#### *Underside.*

D.S.F. ♂♂. Very variable, commonly purplish brown. Discal line, prominent or vague. Ocelli as a rule faint or vestigial or mere dark spots. Occasionally, though not clearly ringed, a full range of light spots.

D.S.F. ♀♀. Generally ferruginous, sometimes of a rich umber tint. Discal line obvious, but perhaps not so defined as in W.S.F. Ocelli very variable; seldom ringed. Thus they may be just black dots, or vague yellowish spots not defined by a line.

GRANHAM,

BERKHAMSTED,

16th December 1944.

J. A. YATES.

#### 22.—STALKED COCOONS.

With reference to Mr. Loke's note (1945, *Journ. Bomb. Nat. Hist. Soc.*, 45: 440) on the cocoon of the Tussar Silk Moth, the pedunculate cocoon of *Antheraea paphia* L. is quite normal. In

addition to this species, a number of Saturniids spin pedunculate cocoons.

Whilst I have never found any of these cocoons *in situ*, both from literature, and from the cocoons of *paphia* and *Loepa newara* Moore that have been given me by friends, I have always understood that they were normally suspended by the stalk alone and had no other support.

Moore (*Lep. Ceyl.*, ii) under his diagnosis of the family Saturniidae, writes 'Cocoon . . . attached to a twig by a silken peduncle, or to pendent leaves by silken threads.' Under *Antheraea cingalesa* Moore, now often considered a sub-species of *Myllitta Drury*, he states 'Cocoon . . . attached to twig by a short coarse silken peduncle', and the figure shews the cocoon standing out almost at right angles to its support. Under *Attacus taprobanis* Moore, now considered a subspecies of *atlas* L., we find 'Cocoon . . . attached to a twig by a silken peduncle amongst the leaves', but the figure does not shew the cocoon *in situ*.

Hampson (*Fauna Brit. Ind.*, Moths, i) under *Antheraea paphia* L., *A. knyvetti* Hamps. and *Loepa newara* Moore states 'Cocoon pedunculate' without giving further details.

Seitz (*Macro-Lepidoptera of the World*, x) writes under *Samia*, 'the cocoon often enveloped in leaves, . . . it is often suspended by a long strong silk cord', and under *Antheraea*, 'Cocoons of *paphia* and *myllitta* shaped like a nut suspended on a long silk thread . . . .'

No cocoon of either *paphia* or *newara* that I have seen has shewn any sign of attachment to a leaf, and none has had the vein marks that are so clearly shewn on the cocoon of *Samia cynthia* Drury, when it is spun in a leaf. The attachment of Mr. Loke's cocoon to a leaf was, I think, rather exceptional.

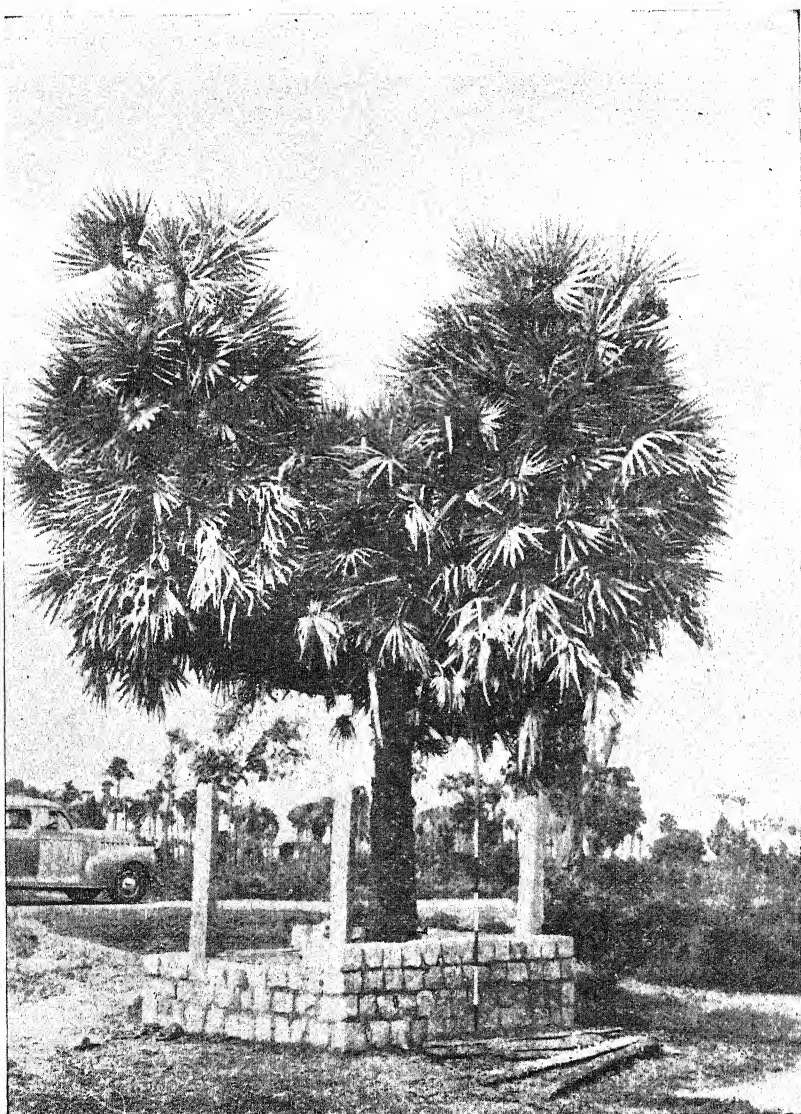
The explanation given for the stalked condition of these cocoons is not merely that of attachment. It is usually considered to be a protection from the attacks of birds, the cocoon merely swinging away on its stalk when pecked at, instead of being torn open as the normally fixed cocoon would be.

*Samia cynthia* Drury normally spins a non-pedunculate cocoon among leaves or along a twig, but sometimes the cocoon is spun inside a single leaf, and the stalk of the leaf is spun over with a layer of silk and fixed firmly to the twig thereby, which prevents the leaf falling. This is, I believe, considered a racial characteristic.

The stalk of the cocoon of *A. paphia* is, of course, pure silk, the individual threads being spun side by side and fusing to form a solid cord.

23.—INSTANCE OF FASCIATION IN PALMYRA  
(*BORASSUS FLABELLIFER*)

(With a photo)



A Fasciated Palmyra Palm.

I am enclosing a photograph of a fasciated Palmyra growing on the side of the Pudukkottai-Ponnamaravaty Road (Road No. 18) in the Pudukkottai State, at mile  $9\frac{1}{2}$  near the Sittur village:

The Palmyra has 12 branches and the main stem is about 12 feet high—cf. the painted 6 foot pole in the photograph placed near the tree. Since the tree has not been observed in flower, I am not able to say whether it is male or female.

The local people have erected a platform round it and worship the tree as the abode of a popular local deity 'Porpanaiyan' who is associated in local legend with the 'golden palmyra'.

This note and the photograph if published will I hope interest your readers.

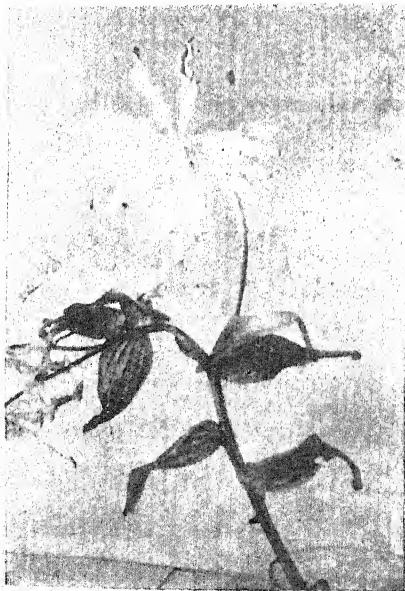
STATE MUSEUM,  
PUDUKKOTTAI (S. INDIA).

K. R. SRINIVASAN, M.A.,  
Curator.

14th November 1945.

#### 24.—AN ABNORMAL FLOWER OF *GLORIOSA* *SUPERBA* LINN.

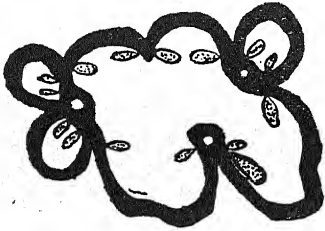
Towards the end of the rainy season Mr. Prater, the Curator of the Society, sent me an abnormal flower of *Gloriosa superba* Linn, which had been collected by Mrs. Waber, a member of the Society.



*Gloriosa superba*. Linn.

The abnormality of the flower is at once apparent in the accompanying photograph and diagrams. There were in all six flowers on the one branch sent to me; five of these flowers were normal, one was very abnormal.

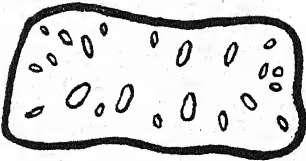
The perianth of this abnormal flower consisted of 13 segments, each of them regular in colour and structure; stamens were also 13, and the anthers and filaments were entirely normal. The ovary was a very striking structure, obviously the result of the fusion of 2 or 3 ovaries. For the sake of comparison I append a diagram of a normal ovary side by side with the ovary of the abnormal flower. In the latter there were externally 9 lobes; on dissecting the ovary, however, it was found that there were only seven lobes, two of them being much more developed than the rest; the placentation of the abnormal flower was of the usual parietal type, with a double row of ovules along each of the sutures. At the apex of the ovary there were two styles, each with three stigmas or stigmatic lobes.



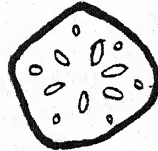
A



B



C



D

*Gloriosa superba*. Linn. A-B: T.S. of abnormal (A) and normal (B) ovary ( $\times 6$ ). C-D: T.S. of abnormal (C) and normal (D) flower stalk ( $\times 8$ ).

Dissection of the stalks of the normal and abnormal flowers showed a great difference between the two types of flowers. The normal flower stalk is roughly quadrangular in transverse section; that of the abnormal flower was rectangular and about as thick as the normal stalk, but  $2\frac{1}{2}$  times as broad. The number of vascular bundles in the regular stalk are 6+6, arranged in two concentric circles; in the irregular stalk there were 23 bundles arranged in a very irregular fashion.

The numbers of the various parts of the flower at once suggest that the abnormality was the result of the fusion of 2 or more probably 3 flowers. The fact that the segments of the flower were not multiples of 6, seems to indicate that there were three flowers fused in such a fashion that some of the segments had been suppressed or lost in the fusing process.

ST. XAVIER'S COLLEGE, BOMBAY.  
5th December 1945.

H. SANTAPAU, S.J.

10. *Guided Reading: 1001 Questions and Answers*





THE YELLOW JASMINE  
*JASMINUM HUMILE* Linn.

$\times \frac{1}{2}$

# JOURNAL OF THE Bombay Natural History Society.

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## SOME BEAUTIFUL INDIAN CLIMBERS AND SHRUBS.

BY

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### PART XXIII.

(Continued from Vol. 46, No. 1, 1946, p. 12.)

(With 1 coloured and 4 black and white plates and 7 text-figures.)

### Oleaceae.

#### The Olive Family.

This family takes its name from one of its genera, *Olea*. *Olea* is itself derived from the Greek word, *elaia*, a name for the Olive. Olive oil was called *elaion* in Greek.

*Oleaceae* is a large family of 22 genera and about 400 species, distributed throughout the temperate and warmer regions of the earth. Included in the family are deciduous and evergreen trees and shrubs with opposite leaves. The leaves are simple or compound exstipulate. Inflorescence various, axillary or terminal; flowers hermaphrodite, rarely unisexual, regular. Calyx nearly always present, small, 4 or occasionally more-lobed, usually bell-shaped. Corolla gamopetalous, sometimes of four petals, often 4-lobed. Stamens 2; anthers apiculate, often back to back, opening lengthwise; filaments short. Ovary superior, 2-celled; ovules usually 2 in each cell. Fruit a capsule, berry or drupe.

The flowers of the species of *Oleaceae* are often sweetly scented and numbers of them secrete a nectar at the base of the corolla, characteristics which indicate fertilisation through the agency of insects. An interesting fact about some species, e.g. *Nyctanthes arbor-tristis* (the well-known *Harsingar*) and various species of *Jasminum*, etc. is that their flowers are fragrant after sunset. In these cases nocturnal *Lepidoptera* act as the unconscious agents of cross-fertilisation. In certain cases, however, for example in the ash, *Fraxinus*, where there is no corolla, the blossoms are pollinated by the wind.

The fruits of the ash are winged but a good many species depend upon an edible fruit for the distribution of their seeds.

One species, the olive tree, is of importance economically. In all countries surrounding the Mediterranean the tree, *Olea europaea* Linn. is cultivated for its fruit. The well-known olive oil may be pressed out of the fruits, which are also used for pickling. Its original home is in Asia Minor but it has been introduced with great success into California. Efforts have been made in the past to introduce this tree into India but with little success so far, though reports from Kashmir are encouraging. In India the tree does not bloom in which case there is no fruit, or if it does bloom, the fruits drop off before they are ripe. It may, however, be possible to achieve success by grafting the European olive on to one of the indigenous olives.

The largest genus in the family is *Jasminum*, of which a large number of species occur in India. The genus is well represented in our gardens and is valued for its pretty sweet-scented flowers and glossy foliage. *Syringa* and *Ligustrum* are sometimes grown in the hills. *Syringa vulgaris* Linn. is the well-known common Lilac of England.

#### KEY TO THE GENERA.

Leaves simple or compound; if simple articulated on the petiole.

Leaves simple, continuous with the petiole.

1. *Jasminum*.

2. *Osmanthus*.

#### *Jasminum* Linn.

The Jessamin, Jasmin or Jasmine.

(This generic name is said to be derived from *ysmym*, an Arabic word. There is, however, no certainty about this and others derive it from two Greek words, i.e. flower, and *osme*, scent).

An important genus of shrubby or climbing plants, comprising about 200 species. Many of these are cultivated in the open in the warmer, and under glass in the colder regions of the world, not only for their pretty flowers and handsome foliage but also for the delicate perfume of the blooms. Leaves simple, 3-foliate or odd-pinnate; petioles articulated. Inflorescence usually, rarely axillary, cymose; flowers bracteate, hermaphrodite yellow, red or white in colour. Calyx usually bell-shape, sometimes cylindrical with 4-9 lobes. Corolla-tube slender, 4-10 lobed; lobes spreading.

Stamens 2, included within the tube on short filaments. Anthers oblong; connective shortly produced. Ovary 2-celled; ovules 2 in each cell, basal, erect; style slender; stigma linear. Fruit a berry.

The well known perfume, Jasmine, is extracted from the flowers by the process known as 'enfleurage', first developed in France. The flowers are lightly spread over a layer of solid fat. Every 24 hours or so the old flowers are replaced by fresh ones so that the fat eventually becomes saturated with the sweet smelling substances. These are subsequently extracted with the aid of alcohol, acetone and other solvents. Another method in use in France to extract the perfume is to spread the flowers on blankets which have been soaked in olive oil, from which it is recovered in the usual way. The principal ingredient of the perfume is a pale yellow oil with small quantities of benzoyl acetate, benzyl alcohol, indole and certain esters. The trade in jasmine oil is very large. In France alone, about 600 tons of flowers are used for this purpose and to this must be added further large quantities produced in Tunis, Algeria and in other countries of the world. Some of the species, used as medicine, bear a high reputation for the treatment of various diseases. The medicinal uses of the various plants will be outlined under the species about to be described.

#### KEY TO THE SPECIES.

Leaves opposite.

Leaves 1-foliate.

Calyx-lobes short, plant hairy.

Calyx-lobes very long; plant very hairy.

*J. sambac.*

*J. pubescens.*

Leaves 3- or more-foliate.

Flowers white.

Terminal leaflets much larger than the others, distal pair not with broad connate bases; leaflets 3-7, lateral acute.

Terminal leaflets not or scarcely larger than the others; distal pair with broad connate bases; leaflets 7-11, lateral usually very obtuse.

*J. officinale.*

Flowers yellow.

Leaves alternate; flowers yellow.

*J. grandiflorum.*

*J. primulinum.*

*J. humile.*

#### **Jasminum sambac** Ait.

#### The Arabian Jasmine.

(*Sambac* is the Arabic name for the shrub, *zambak* in Persian).

*Description.*—A scandent or suberect shrub with pubescent branches. Leaves opposite, exstipulate, petiolate, ovate in shape, 1.5-3.5 in. long by .8-2.5 in. wide, thin, glabrous, obtuse, acute or acuminate at the apex, rounded at the base; lateral nerves 4-6 pairs, prominent beneath and looping within the margin; petioles .2 in. long, pubescent.

Inflorescence in few-flowered terminal cymes or occasionally, of solitary flowers. Flowers white, fragrant, pedicellate or not. Bracts linear-subulate, hairy. Calyx-tube campanulate, tubular, .5 in. long,

5-9 toothed; teeth linear-subulate, longer than the tube. Corolla-tube cylindrical, 1 in. long, 5-9 lobed; lobes acute or obtuse, as long as the tube. Stamens 2, included; filaments short. Ovary 2-celled. Fruit of 1-2 globose berries, each .5 in. in diameter, black, surrounded by the erect, persistent calyx teeth.



Fig. 1.—*Jasminum sambac* Ait.  $\times \frac{1}{2}$ .

*Flowers*.—Hot and rainy season. Does not set fruit in this country.

*Distribution*.—Believed to be indigenous to South India, much cultivated in the tropics.

*Gardening*.—A straggling shrub much prized for its exquisitely fragrant flowers. The white, sweet scented flowers are considered sacred to Vishnu and are largely used by the Hindus for making into garlands. In the tropics the plant is almost invariably attacked by scale insects, usually resulting in a black fungus growth on the leaves. The shrub is consequently best allotted a place in the back ground in an unfrequented spot. The plant prefers a dry location and water must be applied to the roots and not on the leaves and blossoms. When, however, water touches the flowers they usually become blasted, turn black and fall. It flowers best and most profusely when grown in direct sun. Stripping off the leaves is a method commonly used to induce more blossoms. Propagation is by cuttings. It is commonly known by the name of Bela, Motiya or Mogra and has been under cultivation since very early times.

*Economic and medicinal uses*.—This plant has been cultivated since very early times. Double-flowered races are common. The flowers are used to give an aroma to Chinese teas. The perfume is extracted in India by the method known as enfleurage, but instead of fat or oil, crushed sesamum seeds are used. The leaves are

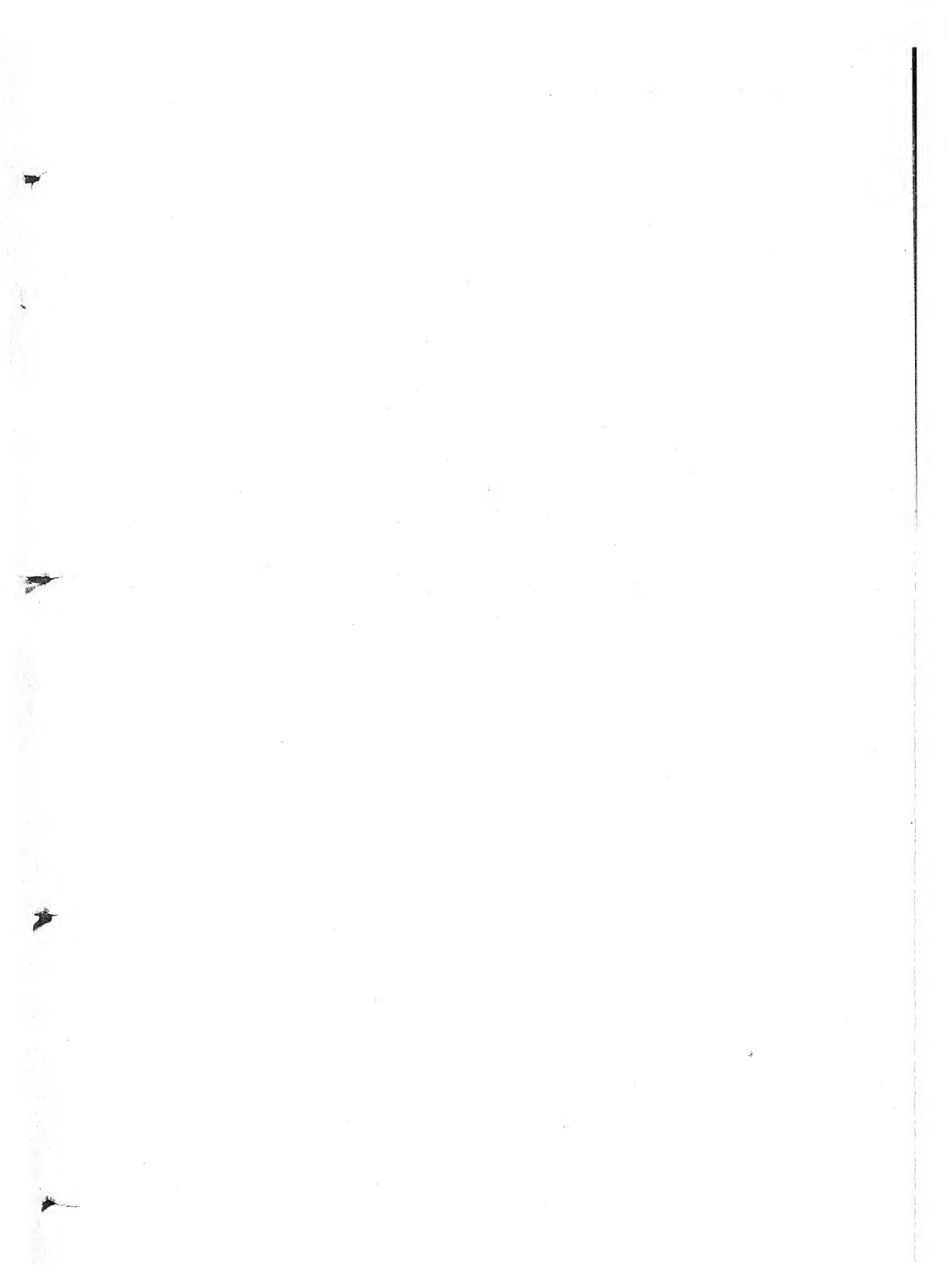




Photo by

N. L. Bor

*Jasminum pubescens*, Willd.  
New Forest, Dehra Dun



used in India as a lactifuge, and are said to be at least as efficacious as belladonna. A decoction of the leaves and root is used for sore eyes.

### ***Jasminum pubescens* Willd.**

(*Pubescens* means hairy in Latin).

*Description.*—A scandent shrub; young parts velvety—tomentose, often rusty. Leaves opposite, simple, entire, petioled, exstipulate, ovate in shape, 1-3 in. long up to 1.5 in. wide, acute or acuminate at the tip, rounded or cordate at the base, upper surface pubescent becoming glabrous, under surface tomentose or pubescent, especially on the nerves; petiole stout, .2-.4 in. long, densely tomentose.

Inflorescence of dense capitate cymes, terminal at the tips of dwarf lateral branches. Flowers white, fragrant, .7-1.5 in. across, sessile or nearly so. Calyx-tube .5-.6 in. long, densely rusty tomentose, 6-9 toothed; teeth subulate, twice as long as the tube or more. Corolla-tube .7-.8 in. long, slender, 6-9-lobed; lobes oblong-lanceolate, acute, shorter than the tube; stamens 2, included. Ovary 2-celled; ovules 2 in each cell. Style slender. Fruit ellipsoid, about 5 in. long, black when ripe, surrounded by the long hairy calyx-teeth.

*Flowers.*—December-April and also during the rains. Fruits May-July.

*Distribution.*—Throughout the greater part of India ascending to 4,000 ft. in the Himalayas, also in Burma and China.

*Gardening.*—A scandent shrub with all parts covered with pubescence. The star-like slightly scented flowers appear practically throughout the year and make this plant one of the most successful of landscape materials, either climbing on a trellis or as a ground cover and low shrub. It is not particular as to soil and sun requirements.

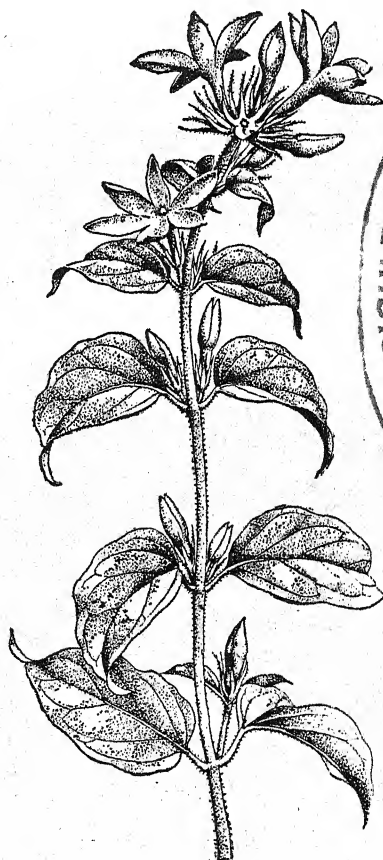


Fig. 2.—*Jasminum pubescens* Willd.  $\times \frac{1}{2}$ .



*Medicinal uses.*—A decoction of the root has some repute as an antidote to cobra venom, and that of the leaves is said to be of use in stimulating static ulcers.

***Jasminum primulinum* Hemsley.**

(*Primulinum* means primrose-like in Latin).

*Description.*—An evergreen twiggy shrub with 4-angled, glabrous, stiff branches. Leaves opposite, 3-foliate, exstipulate, peti-

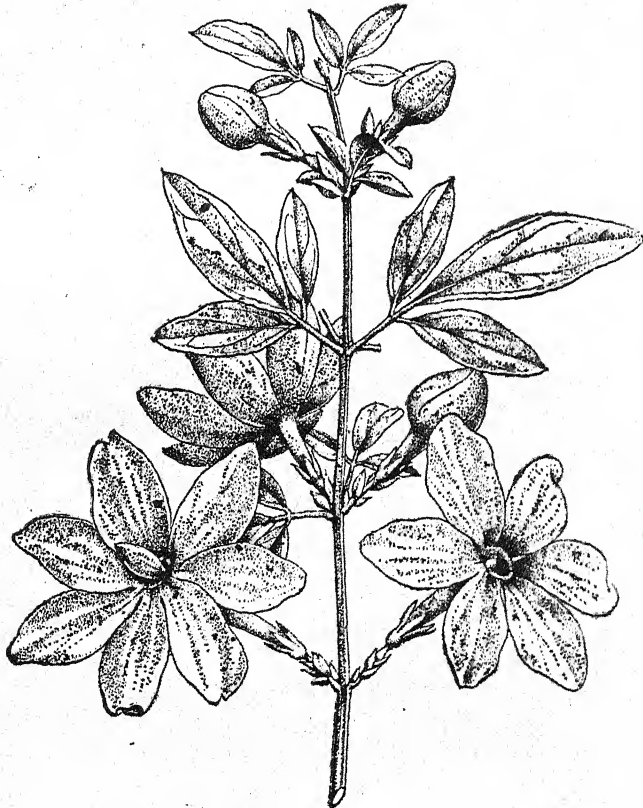


Fig. 3.—*Jasminum primulinum* Hemsley.  $\times 3$ .

olate, up to 4 in. long. Leaflets almost sessile or with a petiole up to .1 in. long, glabrous, narrowly elliptic or oblong-lanceolate; entire, 1-2 in. long, rather thick in texture, apiculate, wedge shaped at the base, dark green and shining above, paler beneath.

Flowers solitary on axillary peduncles, primrose yellow in colour, orange in the throat; bracts and bracteoles foliaceous often scale-like. Calyx bowl-shaped, .1 in. long, 6-lobed; lobes lanceolate, sparsely pubescent, .2 in. long. Corolla-tube stout, increasing slightly in diameter towards the top, usually 6-lobed; lobes obovate; rounded about 1 in. long.



Photo by

M. N. BAKSHI

*Jasminum primulinum*, Hemsley  
New Forest, Dehra Dun



Photo by

M. B. RAIZADA

The Yellow Jasmine  
*Jasminum humile*, Linn.  
New Forest, Dehra Dun

Stamens 2, included. Ovary glabrous, 2-celled; ovules 2 in each cell. Style slender, exserted in single flowers, glabrous; stigma capitate, deeply and acutely 2-lobed.

*Flowers*.—March-May. Does not set seed in this country.

*Distribution*.—Native of Yunan and China apparently as an escape from cultivation, now extensively cultivated throughout the tropical and sub-tropical parts of the world.

*Gardening*.—A rambling, evergreen, shrub of recent introduction. The scentless blossoms of a rich golden yellow characterize this plant. It will thrive in poor soil and under adverse conditions. It has a nice foliage and being semi-trailing it makes a successful ground cover. The plant spreads by layering itself. Propagation is by cuttings or root suckers. It was one of the first plants introduced from China by Mr. E. H. Wilson, for Messrs. Veitch of England. The double-flowered form is the one usually common in cultivation.

### ***Jasminum humile* Linn.**

Yellow Jasmine.

(*Humilis* is a Latin adjective meaning low as opposed to high. It hardly is appropriate when applied to this species).

*Description*.—A diffuse shrub reaching 6 ft. at Dehra, evergreen, glabrous. Branches green, angular. Leaves alternate, exstipulate, petioled, imparipinnate, very variable in size, 2-3 in. long, often 6 in. long in cultivated examples; petiole and rachis channelled above. Leaflets 3-5, very variable in size, rather thick, dark green, paler below, elliptic, ovate or lanceolate in shape, sessile or subsessile, acute or obtuse, wedge-shaped at the base, the terminal up to 4 in. long in cultivated shrubs, the lateral smaller.



Fig. 4.—*Jasminum humile* Linn.  $\times \frac{1}{2}$ .

Inflorescence of terminal corymbose panicles. Flowers bright yellow, seated on pedicels, .2-.6 in. long, furnished with linear

bracts. Calyx-tube .1-.15 in. long, 5-lobed; lobes .05 in. long. Corolla-tube .5-1 in. long, 5-lobed; lobes broadly ovate-obtuse or round, usually reflexed when the flower is fully open. Stamens 2, included. Ovary 2-celled, 4-ovuled. Fruit of 1-2 ripe carpels, ellipsoid, .3-.4 in. long, black when ripe, full of crimson juice.

*Flowers*.—April-June. Fruit September-December.

*Distribution*.—Native of North-West Himalayas up to 9,000 ft. also on the Salt Range, Mount Abu and Nilgiris, widely cultivated throughout the country.

*Gardening*.—An erect, rigid shrub with bright yellow flowers. It is advisable to prune it hard after flowering so as to keep the bush within bounds. Easily propagated by cuttings or seed. It is locally known as "shanjoi".

*Medicinal uses*.—This plant is not of much repute medicinally but the root is said to be useful in curing ringworm.

### **Jasminum officinale Linn.**

#### The White Jasmine.

(*Officinalis* means medicinal, officially recognised as a drug).

*Description*.—A twiny shrub with striate branches, sparsely hairy when young. Leaves opposite, exstipulate, imparipinnate, 2-4 in.

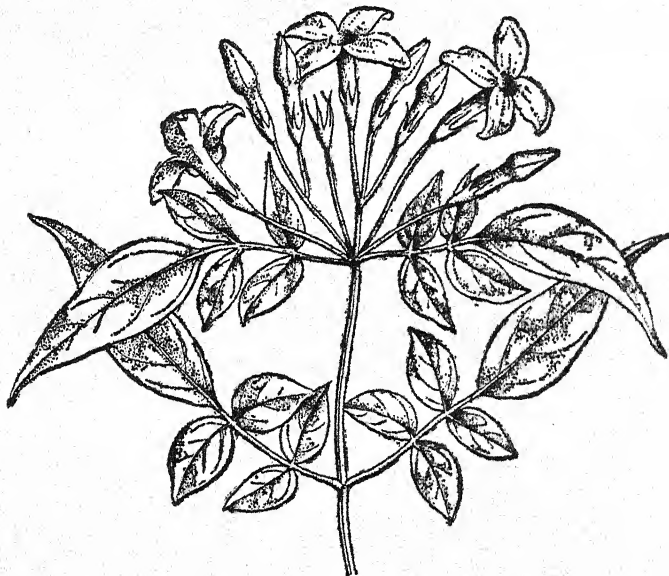


Fig. 5.—*Jasminum officinale* Linn.  $\times \frac{1}{2}$ .

long; petiole and rhachis narrowly margined. Leaflets 3-7, the terminal 1-3 in. long by .4-1 in. wide, ovate or lanceolate, acuminate, usually larger than the lateral leaflets which are shorter and

relatively broader, acute, sessile or shortly petiolulate, the distal pair sometimes with broad connate bases.

Inflorescence of terminal few-flowered corymbs or cymes and axillary pedunculate few-flowered cymes shorter than the leaves or the cymes often reduced to single flower; pedicel of the cyme-flowers .3-.7 in. long, those of the solitary and corymb-flowers often much longer; bracts up to .5 in. long, linear-subulate or narrow linear. Calyx-tube .1-.15 in. long, puberulous, 5-lobed; lobes subulate, .2-.6 in. long. Corolla-tube .5-.7 in. long, cylindrical, 5-lobed; lobes ovate or elliptic. Stamens 2, included. Ovary 2-celled; ovules 2 in each cell. Fruit black when ripe, elliptic or globose, .3-.4 in. long, full of crimson juice.

*Flowers*.—May-June. Fruit. October-November.

*Distribution*.—Native of Persia and Kashmir now widely distributed throughout India, wild or cultivated.

*Gardening*.—This plant, whose native home is in Persia and Kashmir, has been in cultivation in India and China since very early time. It has been introduced into the milder parts of Europe and has become established. It is a loose climbing "vine" requiring a support but scarcely self-climbing. The glossy foliage and fragrant white flowers which appear during the hot weather render the plant very attractive. Like *J. grandiflorum* it is of vigorous growth and hardy and requires periodic pruning. Easily propagated by cuttings.

*Medicinal uses*.—It is mentioned in Chinese medical books dated about the 17th century, as a valuable aphrodisiac. A decoction of the root is said to be of use in ringworm cases. The fruits are reputed to be narcotic and sedative. The fragrant oil from the flowers is mixed with sesamum oil and rubbed on head as a nerve-sedative.

### ***Jasminum grandiflorum* Linn.**

The Spanish Jasmine.

(*Grandiflorum* means large flowered).

*Description*.—A large shrub with striate, glabrous, almost angled branches. Leaves opposite, exstipulate, petiolate, 2-5 in. long; petiole and rhachis margined. Leaflets 7-11 in number, the terminal somewhat larger than the lateral but not markedly so, glabrous, dark green, entire, the upper lateral pair with broad flat base, often confluent with the terminal, the lowest pair with short petiolules, the intermediate pairs sessile, the terminal acuminate at the tip, wedge-shaped at the base, the other apiculate at the tip and rounded, often obliquely at the base.

Inflorescence in lax axillary or terminal cymes longer than the leaves. Flowers white, very fragrant, often tinged with red outside, pedicellate; pedicels .5-1 in. long; bracts ovate to spatulate-oblong, foliaceous; bracteoles small, linear. Calyx-tube campanulate, .1 in. long or less, glabrous, 5-toothed; teeth subulate, two to three times as long as the tube. Corolla-tube cylindrical, .7-1 in.



long, glabrous 5-lobed; lobes elliptic or obovate, obtuse. Stamens 2, included. Ovary 2-celled, 4-ovuled.

*Flowers*.—Hot and Rainy season. Fruit. Cold season.

*Distribution*.—Native of the North West Himalayas up to 7,000 ft.; extensively cultivated in gardens both in the plains and hills.



Fig. 6.—*Jasminum grandiflorum* Linn.  $\times \frac{1}{2}$ .

*Gardening*.—A large twining or scandent shrub of vigorous growth, hardy and drought resistant. The leaves are impari-pinnate and the flowers which are pure white and fragrant are bigger than those of *J. officinale*. On account of the great demand for the buds of this species it is extensively cultivated. It is rather a troublesome plant to keep within bounds as it spreads over a large space sending forth roots from its stems wherever they touch the ground. It is suitable for a light trellis and is quite attractive because of its graceful deep green foliage and scented flowers. To induce profuse flowering it is best to prune in November-December and manure in March-April. Easily propagated by cuttings. It is popularly known as "chameli".

*Economic and medicinal uses*.—The leaves and flowers have long been known in Hindu medicine. The leaves contain a resin, salicylic acid, an alkaloid, jasmnine, and an astringent principle. The leaves are astringent in action. The whole plant is considered to



Photo by

M. B. RAIZADA

The Spanish Jasmine  
*Jasminum grandiflorum*, Linn.  
New Forest, Dehra Dun





be anthelmintic, diuretic and emmenagogue. The perfume from the flowers is extremely valued and is cooling in action.

This is the plant commonly cultivated in Europe for the perfumery trade. Up to the present the chemists have not been able to copy it exactly in the laboratory, as the synthesis of ketone found in the oil of the flowers, which gives a distinctive scent has not yet been accomplished. The juice is said to be anthelmintic and an antidote for scorpion sting.

### **Osmanthus** Lour.

(The generic name means fragrant flower in Greek).

A small genus of evergreen trees and shrubs with serrate or entire, opposite or alternate short-petioled leaves. Flowers fascicled or in very short racemes, perfect, polygamous or dioecious. Calyx short, 4-toothed. Corolla short- or long- tubular, 4-lobed; lobes 4, obtuse. Stamens 2, rarely 4; inserted on the tube. Ovary 2-celled; ovules 2 in each cell pendulous from the apex; style short, 2-lobed or entire. Fruit an ovoid or globose drupe with a one-seeded stone.

### **Osmanthus fragrans** Lour.

*Description.*—A shrub or small evergreen tree. Leaves opposite, petiolate, exstipulate, glabrous, coriaceous, 7 in. long by 2



Fig. 7.—*Osmanthus fragrans* Lour.  $\times \frac{1}{2}$ .

in. wide, entire in wild but serrate in cultivated plants, elliptic to oblong-lanceolate in shape, acute or acuminate at the tip, wedge-shaped at the base; reticulation prominent beneath; petiole .6 in. long.

Flowers yellowish, very fragrant, .25-.75 in. long, densely fascicled in the upper axils, rarely terminal, shortly pedicellate. Calyx minute, .03 in. long, 4-toothed. Corolla-tube very short, 4-lobed; lobes oblong, about .3 in. long. Stamens 2, inserted in the corolla tube; anthers exserted; filaments short. Ovary 2-celled; ovules 2 in each cell, pendulous. Drupe 1-seeded.

The flowers of this species are extremely fragrant and will scent the air for a considerable distance round a plant. The sweet-smelling flowers are said to be used by the Chinese for scenting their finer qualities of tea.

*Flowers*.—October. Also at other time of the year. Fruits. April.

*Distribution*.—Native of the Himalayas extending to China and Japan.

*Gardening*.—An attractive, evergreen shrub with dark green glossy foliage. The tiny pale yellow flowers have a strong smell very like apricots and it is for the love of the fragrance that it is extensively cultivated. It prefers partial shade and is propagated by cuttings or 'gooties'. It is popularly known as *Olea fragrans* in gardens.

(To be continued.)

## CIRCUMVENTING THE MAHSEER AND OTHER SPORTING FISH IN INDIA AND BURMA.

BY

A. ST. J. MACDONALD.

### PART XI.

(Continued from page 58 of volume 46).

#### Locality Index.—

1. Assam and Dooars.
2. Bengal and Chittagong Hill Tracts.
3. Bihar and Orissa.
4. Bombay.
5. Burma.
6. Central India and Rajputana.
7. Central Provinces.
8. Madras (including Hyderabad State, Mysore State, and Eastern and Western Ghats).
9. Punjab and N.W.F. Province and Baluchistan.
10. United Provinces and Delhi.

#### LOCALITIES.

This Index of River and Tank Localities does not aim at being exhaustive, nor providing detail beyond acquainting the reader with some of the places where fishing is still to be had.

'The Angler's Handbook' and 'The Angler in Northern India' both provide detailed notes by individuals—unselfishly given 18 or

20 years ago, if the angling community to-day will co-operate on the same line and send notes on rivers and tanks listed therein, with any additional notes, to me direct or to the Society, a full and up-to-date chapter on Localities, or a second part to this book, can be compiled and published for the benefit of all.

The object of this Index is to give a brief list of Localities that the enterprising angler can trace by means of a Gazetteer, or the Road Map of India, or Survey of India Maps, or through local enquiry. The size of the river will generally indicate the size of the fish to be taken.

Detailed maps and sketches are outside the scope of this little book. The chapters on Assam and Burma include some of the best localities and must suffice until more information is forthcoming.

1. ASSAM AND THE DOOARS. See Chapter viii.

2. BENGAL AND CHITTAGONG HILL TRACTS.

*Bengal* is dealt with under Chapter viii, or rather those portions in North Bengal that are well known in the Districts of Darjeeling, Jalpaiguri, and Mymensingh.

*The Chittagong Hill Tracts* of which very little is known or, more correctly, advertised, have some good rivers in which mahseer are plentiful but owing to the difficulty in getting to the best places, and the time and 'bundobast' involved, little attention has been given to this secluded part of the Province.

Nothing is known of the Estuary fishing either; but it can be safely asserted that Bahmin and Cock-up will be found in all the many estuaries all the way down the coast to Akyab and beyond.

DISTRICT.	RIVERS & TANKS.	REMARKS.
Chittagong.	Karnaphuli. R.	I have been given most attractive accounts of the Races and Pools of the upper waters above <i>Rangamati</i> and <i>Barkal</i> in the tributaries Sajjuk and Maiyani by a non-angler.
	Sajjuk. R.	
	Mayani. R.	
	Sanju. R.	This river, further to the south, also traverses wild country and holds promise of good sport.

3. BIHAR AND ORISSA PROVINCES.

*Bihar*, north of the Ganges has numerous rivers draining through to the South-East. Above Patna the Gogra and Gandak join in from the left bank, and the Sone from the right bank, swelling the Ganges to three times its former size; further East the Kosi another huge river, runs over the country in numerous channels and joins the Ganges in the Purnea District.

There is an abundance of fish life of all kinds though little to offer the Angler, except in the smaller streams where one can have good sport with Butchwa and sometimes Silund. But for the Tank Angler this provides the best fishing in India. There are innumerable lakes formed in the Districts of Champaran and Mozufferpore which hold monster Rohu and Catla, besides all the predacious fish. There are numerous tanks dotted all over

the country, almost one or two in each village, stocked with fish of all kinds.

In the Darbhanga District there are huge tanks too large to net to extinction, besides many others protected by Zemindars who will permit fishing if approached. In Darbhanga itself there are a number of large tanks, almost lakes, that hold enormous fish, in which one may fish after obtaining permission from the Raj.

To list these tanks would fill a tome. Local enquiry will soon satisfy the Angler; and the nature of the tank with its old banks and trees will indicate the age of the tank and size of fish to be expected.

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Champanan.	Gandak R.	<i>Tirbani.</i> North of Bagaha, is in the N. corner of the District and is the headworks of the Canal. I have been told of some rapids below this point, but no one appears to have caught any Mahseer here though the 'Malars' bring in 30 and 40 lb. fish for sale into the local markets.
	Fanks.	<i>Bettiah. Raj.</i> Have some tanks well stocked with Rohu being protected from netting; permission to fish can be obtained.
	Lakes.	<i>Motihari.</i> Has two large lakes (the old bed of the Buri Gandak) full of fish. These lakes continue all the way down to Mozufferpore on both sides of the Buri Gandak, which flows in a south easterly direction, joining the Ganges in Monghyr District.
	Buri. Gandak R.	Fed from Nepal it is confined between high banks throughout its course in Bihar. It runs clear and is full of all kinds of fish, and gives good sport with Butchwa and Silund, but is little fished.
Mozufferpore.		<i>Mozufferpore.</i> It enters the District near Mehsi and leaves it near Pusa. The same remarks hold as those mentioned for Champanan. It passes through Mozufferpore town to the North.
	Lakes.	There are a number of lakes similar to those in Champanan in this District. Also plenty of good tanks.
	Bagmati R.	Flows into the District from Nepal near Dhang St. on O. & T. Ry. in the North of the District Mahseer have been caught at the bridge, but for the best fishing one must go into Nepal, where it is excellent, but permission must be obtained: No easy matter, as it is the sacred river of the Country. In its lower reaches it gives good sport with Butchwa and the other predacious fish. It also flows into the Ganges in Monghyr District.

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Darbhanga.	Buri. Gandak R.	Enters the District near Pusa and leaves it at Rusera passing through Samastipore on its way, I know of good Silund being caught at Dowlatpore 3 miles from Rusera. It is little fished or would give good results. Tank angling is so good that the rivers receive little attention.
	Bagmati R.	The Darbhanga line crosses the river at Hayaghat Stn. It is very similar in formation to the river Gandak with the same fish.
	Tanks.	There are literally hundreds to choose from and local enquiry will satisfy any one interested. I took out of the Mohanpore tank near Ryam three Rohu one evening of 33, 32, 30½ lbs. and with another rod in a tank near Benipore 17 fish in three hours best 17 lbs.
Chupra.	Tanks.	In Chupra at the old Dharamsala is a very old Tank, where the fish are fed, and one can see 20-40 lbs. Rohu come up and take parched rice on the surface; fishing is not permitted. There are other tanks but it is poor in comparison to the other Districts mentioned. The rivers are too large to be worth while.
Bhagalpore	Kosi R.	North Bhagalpore is drained by the many channels of this mighty river that knows no bounds, and shifts its course as much as 30 miles in a single Monsoon Season. From a fishing point of view it holds little attraction in the District, except for netting of the parish fish, of which there is a good supply. The Ganges is at Bhagalpore but it is a vast wilderness of water, and uninteresting from an Angler's point of view.
Purnea		I have heard of good fishing in the Kosi in the North of the District, but for Mahseer one must get into Nepal, for which special permission is required. I have had great accounts of the water below the last gorge and where the river fans out into a sort of delta and breaks up into several large channels and some excellent fishing is available.
	Kosi R.	The main channel of the Kosi passes under the Ry. at Kursala forming the boundary of the District with Bhagalpore, but is flat and sandy, and uninteresting.
	Panar & Kankai R.	Further east the Panar and Kankai rivers drain from Nepal into the Ganges, but nothing is known of the fishing. A large portion of the fish from this District is sent to the Calcutta market,

DISTRICT.	RIVERS & TANKS.	REMARKS.
Purnea.	Panar & Kankai R.	There are a number of very old and large tanks belonging to the Darbhanga Raj, with excellent tank fishing. There are besides a number of lakes, formed by the old river bed of these wandering streams, in which good sport can be had with murrel.

South Bihar and Orissa has hilly country with a number of rivers feeding the *Sone* in the North-West, chief of which is the *Koel*, in the Palamau District which holds Mahseer, and has a number of good runs and pools near *Daltongung*.

West of *Daltongung* lie the Eastern States of the C. P., *Surguja* etc., with wild hilly country and a network of rivers, with great possibilities. Little is known of this tract of country from the Angler's point of view. The *Rer*, and another large stream just above *Bardi* join the *Sone*, and should hold Mahseer.

The *Bashda* rises near *Sonhat* and flows south to join the *Mahanadi*, but there must be many other good streams of which nothing is known.

Further South in Orissa are the Feudatory States with the *Ong*, *Suktel*, and *Tel*, all of which flow into the *Mahandai* near *Manda* in Sonpur State. The *Tel* is the largest of these and has a number of tributaries in *Kalahandi* State.

The *South Koel* in *Singbum*, and *Santh* further West join in *Gungpur Stream* and run on as the *Bhramini* River entering the Sea at *Hansua*.

*Ganjam* District is one of the districts ceded to Orissa by Madras, in the extreme South. It also has a number of rivers but no notes are available.

#### 4. BOMBAY PRESIDENCY.

These brief Notes are only part of the wealth of information that must be available to Anglers. I have avoided mention of Sea Fishing as this is dealt with under Chapter II.

For those interested I can do no better than recommend that excellent publication by the B.N.H. Society 'Game Fishes of Bombay'. It has coloured illustrations of a number of fish and contains a host of information. It is sold at the very modest price of Rs. 2/-.

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Ahmadnagar.	Godavari R. Prewara and Mula R.	Forms the N. and N. E. boundary with Aurangabad. These two rivers join at, or just above <i>Nevash</i> and flow on for 12 miles or so to join the Godavary; running through some wild country. <i>Pailhan</i> on the borders of the Aurangabad District has a junction but no details are available. The Gazetteer would help.
Ahmedabad.	Subarmati R.	A huge pool about a mile from Cantonments below <i>Achar</i> , V, on the opposite bank, with a slow run into the top of the pool, and up-

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Ahmedabad—(contd.)	Subamati R.—(contd.)	der a cliff on the far bank. It is good in the late evenings and early mornings. I had good sport here in 1919! and caught several fish of 4 and 6 lbs. Mahseer <i>Kanker-Beds</i> . 6 miles up-stream are some rapids we knew as the Kankerbeds, it is past the pig-sticking country, and under a cliff. I had grand sport with Mahseer of 8 lbs. and Rohu of 4 lbs. which I caught with green weeds used as a fly. It is a long, tiresome trudge, but worth it.
		<i>Rayasan</i> . 14 miles up-stream, and connected by bad road, has some good water but it varies from year to year. The pool at the place may go off and the water at <i>Koha</i> . V. 3 miles down improve, or at <i>Radasan</i> 1½ miles above.
		<i>Mehmedabad</i> . Half a mile by rail south of Ahmedabad, some good water a mile or so above the bridge. There are besides some good places up the Metre gauge line where I had good sport with fly spoon about 4 stations out. Notes lost.
Belgaum.	Gatprabha R.	<i>Sutgatti</i> . 17 miles from Belgaum holds fish up to 20 lbs.
		<i>Punderi</i> . 32 miles from Belgaum, with a R. H. a few hundred yards from the river, which is quite good water.
	Tamrapani	Tambulwadi R. H. and bridge over the Tamrapani stream, a tributary of the Gatprabha also holds Mahseer.
	Dhupdal L.	<i>Dhupdal</i> . Station has a large lake formed by an artificial bund which holds fish.
	Gokak Falls.	<i>Gokak Falls</i> three miles down stream has a deep pool full of fish but difficult to approach. These rivers run dirty for a considerable time after rain, which takes away from their attraction.
Bijapur.	Kistna R.	<i>Kistna</i> is joined by a river from Belgaum, I think it is the Gatprabha, which fishes well in the Belgaum District. No first hand notes available.
Bombay.	Ulhas R.	<i>Ulhas R.</i> (Kalyan Creek) the tidal part of this from Bassein up to the Railway bridge some miles above Kalyan is good for Bektie or Cock-up wherever there are rocks. Fish much over 50 lbs. have been caught on live bait. Spoon is entirely useless. Plugs are better. Fish are not plentiful. Best time August/October in turbid water. Bahmin do not ascend the creek much above Ghod Bunder.



DISTRICTS.	RIVERS & TANKS.	REMARKS.
Bombay—(contd.)	Kalu R.	<i>Kalu R.</i> the non-tidal parts of this, an affluent of the Uhlās, and of the Uhlās itself, hold carp and Mahseer up to and above 15 lbs. in restricted numbers. A well known spot is near <i>Neral</i> . Murrel and Wallago also frequent those waters.
	The Ghat Lakes.	Lakes <i>Andra</i> (L. Gibbs), <i>Walwan</i> , <i>Sheravata</i> , and <i>Mooljee</i> (the latter at the head of the Moola valley) all hold fairly good mahseer and carp ( <i>Barbus dobsoni</i> , <i>B. jerdoni</i> ) the largest in <i>Muljee</i> Lake. Permission to be obtained from Messrs. Tata & Co. Bombay. A collapsible punt is very desirable for successful fishing in these lakes. Trolling, spinning, and bait-casting are successful.
	Lake Tansa.	<i>Tansa</i> 55 miles north of Bombay provides part of the water supply.
	L. Bhiwandi.	<i>Bhiwandi</i> 29 miles from Bombay approached by Agra road.
	L. Beale.	<i>Beale</i> between Gote and Asvali Stations is 17 miles long. <i>Niphad</i> Stn. is near the lower lake formed from Lake Beale and connected by the Darna R.
	L. Arthur Hill.	<i>Igatpuri</i> . 26 miles S. and formed by the Bhandaradara Dam. It feeds the Pravara R. 14 miles of good water with fish up to 20 lbs.
	L. Andra or Gibbs.	<i>Andra</i> . A good many miles to East of Bhor ghat is also a good place.
	L. Sheravata.	<i>Lonavla</i> . In the neighbourhood is this Lake also <i>L. Walwan</i> which is reported to hold big fish. Most of the fishing in the lakes is mixed and anglers will tackle chilwa if nothing else is available. It is treated rather as a side show.
N. Kanara.	Kalinadi R.	<i>Kalinadi R.</i> This and other rivers <i>Gangavali</i> , <i>Tadri</i> , <i>Sharavati</i> (on which Gersoppa Falls, 830 ft.) all hold mahseer, together with their tributaries. All these rivers drain the District westwards into the Arabian Sea. No detailed notes are available.
Khandesh.	Girna, Tapti, Panjkra, and Bari Rs. also the as to Narbada for wh: see C. P. Section.	No notes in the fishing books but there must be many places where good mahseer fishing is to be had by the adventurous angler.
Poona.	Lake Fife.	Near <i>Rhadakwasla</i> . Fish are taken trolling with spoon or dead bait. 'Mahseer Fishing in the Deccan Lakes' by Major Trevenen, <i>Bom. N. H. S. Journal</i> , vol. xxxi, p. 120 is a good reference.
	Bhima R.	<i>The Upper Waters</i> . About 10 miles north of the Nasik road the

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Poona—(contd.)	Bhima R.—(contd.)	river is fishable for mahseer up to 10 lbs. or so in various runs, during and immediately after the rains for a short time only. There is a rocky chasm quite often holding huge goonch and fair-murrel, besides mahseer. <i>Bhima R.</i> This holds good for the fish in the fine pool below the confluence above <i>Pargao</i> village, I have seen mahseer of 30 lbs. netted there. The big pool near <i>Nandgaon</i> (off <i>Patas</i> ) is too broad for fishing from shore. It becomes shallow in the dry weather and is good in and shortly after the rainy season only, when large fish may frequent it. The rocky runs below the pool, and the water into which they run, are also good in the same season. A dug-out canoe is usually procurable at the big pool at one or other of the villages. <i>Patas</i> is 40 miles from Poona on the Sholapore road.
	Mula R.	<i>The upper waters of the Mula</i> , i.e., from above Kirkee to Kooljee Lake, present several fair runs shortly after the rains and good pools throughout the year with carp and mahseer rarely over 10 lbs. Also fair murrel and wallago <i>Mutha</i> <i>Mula R.</i> The pool at Kirkee is still fairly tenanted. There are now three dams below it including the one near the Fitzgerald bridge, so that fish can no longer reach their old spawning grounds in the upper valley. The spot near 'Snake Island', which still haunts the literature, is completely useless since many years for spinning and trolling and holds no sizable mahseer nowadays. The stretch below the bridge and up to the Cavalry falls is still frequented by a few fish up to 25 lbs. during and shortly after the rains, but sizable fish are few and far between. They respond to spoon, dead bait, and plug, but prefer paste, crab, or such country baits as chapati or a triangular slice of coconut spun like a spoon, with a single hook tied to it, or better still the single hook concealed between two thin slices. This is a very killing bait in slightly coloured water. It spins very well in fairly fast water and is very attractive. Further down there are good runs at <i>Loni</i> and <i>Theur</i> yielding fish of the same size, but not many.

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Poona—(contd.)	Mula R.—(contd.)	I believe that the three dams in Poona have made the river unpopular with mahseer as these three dams create a dead end, or 'culdesac'.
		The pool just above the confluence with the Bhima still holds a few good mahseer, but they disdain all artificial lures. Bottom fishing is the only way with them.
	Ghod R.	Ghod R. The part north of the Nasik road runs through pretty wild country and holds some great fish in the vicinity of Ambegaon Fishable after the rains. This part is not easy of access and camping is a necessity. A deep, rocky chasm on a small tributary some 16 miles from Sirur holds large fish (mahseer and silund) very difficult to land as the rocks are high above the water. This is certainly the place mentioned in Thomas's 'The Rod in India' 2nd edition 1881, page 337.
		The word 'Dav' in the same para probably refers to the village Dehu on the Indrayani River in the Poona area.
		I have seen mahseer up to 50 lbs. netted in the Ghod R. some six miles from Sirur where their retreat down river had been barred by a palisade of stakes. This was after the rains when large fish retire from their spawning grounds in the Ghats and return to the deeper waters of the Bhima lower reaches. Very large goonch are also caught there.
		This, by the way, is the type locality for Sykes's <i>Barbus mussullah</i> the very hump-backed and heavy, golden-bronze coloured mahseer of the Deccan, which I believe to be identical with the record fish of the Cauvery river. It is distinct from the ordinary more slender Deccan Mahseer which Dr. Hora has classified as <i>Barbus (Tor) khudree</i> , Sykes.
		All the above as to Poona rivers also Ulhas R. and Ghat Lakes is, contributed by Dr. M. Suter, D. Sc., and gratefully acknowledged.
Poona.	Indrayani R.	Shelavadi Station on Lonavla-Poono line is 4 miles from Dehu where is a temple and pool full of sacred fish up to 40 lbs. and over.
	L. Whiting, Nira R.	Bhartgarh. The Lake is formed by the Lloyd Dam and Nira R. which also carries off the overflow. Good fishing is reported in both the lake and river.
		Ing. 3 miles below the lake has some good runs.

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Satara.	Warna, Keina, Yerla Rs.	The Warna is in the South. The Koina runs through the centre, and the Yerla in the East of the District. All are tributaries of the Kistna and must hold fish. No notes available.
Surat.	Farr R.	<i>Bulsar.</i> Take a bus on to the river. Good sport is reported both above and below the Ghat.
	Kolak R.	<i>Udvad Stn.</i> The river is two miles south of the Station. Holds mahseer and other fish.
	Dhamanganga R.	<i>Dhaman Rd. Station.</i> The river is $1\frac{1}{2}$ miles South of the Station. A few miles up-stream is reported to be well stocked with fish, both fresh water and estuary.
	Sanjan R.	Two miles below the Ry. bridge and near the Salt Dept. bungalow is reported to have good estuary fishing.
		<i>Sanjan R.</i> 1 mile South of the Sen Station is well stocked with estuary fish.

A reference to the Road Map of India will show the Angler that there are great possibilities for estuary fishing all along the Surat coast where the Tapti and Narbada rivers enter the sea.

#### 5. BURMA, see Chapter vii.

#### 6. CENTRAL INDIA AND RAJPUTANA STATES.

Little is known of the fishing in this vast area, except perhaps by the privileged few, keen on fishing, who have served in these States.

There are said to be large mahseer in some of the Udaipur Lakes. In earlier days, as we know from articles in the Oriental Sporting Magazine of the middle 19th century, the Chambal river and its many tributaries afforded large catches of *Barilius Bola*. It is probable that the same species still afford opportunity to those who can visit those regions.

Skene Dhu makes brief mention of indifferent fishing near Mhow. Notes regarding the Narbada River in the Central Provinces and Bombay localities lists should be referred to.

Any Notes on the Chambal and other rivers would be of interest to Anglers and science alike.

STATE.	RIVERS & TANKS.	REMARKS.
GWALIOR STATE.	Chambal R.	The largest river in Central India. It rises in Indore near Mhow taking in a large number of tributaries of considerable size which rise in Kotah, Bundi, Nerwar, Datia, etc. It runs in an Easterly course skirting Gwalior State on the North to join the Jumna near Etawah. (U.P.).
Kotah, Bundi, Nerwar and Datia		<i>Mhow.</i> is well situated for the streams in the South of the State that drain the Satpura R. into the Nerbudda.
Indore State.	Nerbudda R.	

DISTRICT.	RIVERS & TANKS.	REMARKS.
Rajputana.	W. Banas R.	<i>Banas R.</i> rises in Sirohi in the South the drains the western portion of the Aravalli Range, and runs into the Runn of Kutch.
	Sabarmati R.	<i>Sabarmati R.</i> also rises in this range (for notes on this R. See under Ahmedabad).
	Mahi R.	<i>Baswara &amp; Durgapore.</i> The Mahi rises in the hills in these districts, it is wild hilly country, but nothing is known of the fishing or fish.
	Banas R.	Not to be confused with the Western Banas which runs west. The Banas also rises in the Aravalli R. but follows a North-Easterly course, taking in the Kheri, Kotari, from the West and the Berach from Tonk State near Udaipur. The Banas joins the Chambal about 20 miles East of <i>Sawai-Madhopur Jn.</i> on the B. B. & C. I. Ry.

## 7. CENTRAL PROVINCES.

This Province may well be divided into four sections. The North is drained by the tributaries of the Jumna; the West and Centre by the Narbada and Tapti flowing into the Arabian Sea. The South and South West and greater part of the Central portion is drained by the largest of its rivers flowing into the Godavary through the Warda, Penganga, and Wainganga, which form the Pranhita. The East has the Mahanadi and Seonath, with their many tributaries, leaving the Province at Chandranpur.

DISTRICT.	RIVERS & TANKS.	REMARKS.
Amraoti.	Ganga, Katbi, Sipna Rs.	<i>Ellichpur.</i> For full details see under Khandwa.
	Wainganga River.	Dongaghat is a good place with fish over 20 lbs. The large fish are taken on atta, the smaller ones take spoon. For further details refer to District Gazetteer for detail of approach.
Bhandara.	Wainganga R.	Padregunj, a little south of Nainpur on B. N. Ry. has some excellent water, I have heard of big fish being taken and others lost.
		The Laknagunj Gorge, up-stream a couple of miles, is a celebrated place, fish take both spoon and atta.
		<i>Wainganga R.</i> there is very good fishing in this District but I regret I have lost the Note sent to me by a Forest Officer who caught some good fish both in this river and the one which drains the District further East! (name not available). It joins the Wainganga just north of Ambgaon (in Chanda) in the extreme South of the District. Fish well over 20 lbs. were caught by this rod.

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Bhandara—(contd.)	Wainganga R.—(contd.)	36 miles from Nagpur on the Raipur road are some good rapids down stream about 9 miles. Bait with atta, then fish with spoon or paste balls when fish have collected.
Bilaspur.	Hasdeo R.	<i>Hasdeo R.</i> a tributary of the Mahanadi and joining it at Seori Narayan a few miles below. Banjo in Uprora Zemindari has some good water; Best mentions in his Shikar notes some good water 15 miles north of the Railway.
Chandrapur.	Mahanadi R.	<i>Mahanadi R.</i> Padampur, and water between Seori Narayan and Chandrapur is good, with fish over 20 lbs. For details refer to Dist. Gazetteer.
	Maniari R.	<i>Maniari R.</i> a tributary of the Seonath R. and joining it at Satti Ghat about six miles S. S. W. of Bilha Ry. Station or 15 miles S. W. of Bilaspur.
		<i>Lormi</i> on this river is mentioned by Best as a good spot, and fishes all the year round. Fish of 5 lbs. have been taken. The route to Lormi is <i>via</i> Mungeli 30 miles, then by track for 16 miles. There is a Rest House, P. O. and Police Station at Lormi on the banks of the river. 30 miles from Bilaspur where the Raipur road crosses the river, is said to be good.
	Seonath R.	<i>Seonath R.</i> Nandghat. A good run 600 yards above the bridge, and another run about the same distance below.
Buldhana.	Tank.	The drinking water tank has good Murrel and a few Butchwa. Good fun can also be had with chilwa with a fly. It is a mile out.
	Khamgeon Tank.	<i>Khamgeon Tank</i> also has a large tank and it is here I have caught Murrel on fly in the evening and when the shoals are rising. The only place I have found Murrel rise in this way.
Chanda.	Indravatti R.	<i>Indravatti R.</i> joins the Godavary in the S. E. corner of the district.
		Allapillai 75 miles then on to Repanpalli 21 miles along the Seroncha road. Turn off the main road close to R. H. and go East by a cart track to Damarincha (15 miles) to Palli another 15 miles, total 51 miles, near Damarincha is the Bandia R. a sandy bed and heavy going. Except for this river the cart track, offers no difficulty. Make for Bhamragarh 4 miles upstream where there are several runs and reports of monster but elusive fish. At Bomragarh is a Bungalow.

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Chanda—(contd.)	Indravatti R.—(contd.)	<p>Semanapalli about 6 miles above junction of Indravatti and Godavari has a pool full of big fish. A Forest R. H. here.</p> <p>One hears wonderful accounts of monster fish of 80 lbs. being seen and tackle broken. It has always remained a dream of mine.</p> <p>An old shikari reading these notes writes that when he was at Warda. Junction on 22nd March 1898, on way to Chanda and the Indravatti, he met an Officer from Poona who had had all his tackle torn to bits by huge mahseer of the Indravatti.</p> <p>He (my present informant) was at Damarincha by the 26th April 1898 and caught a small mahseer of the thick lipped type. Then he got bad remittent fever and had to return to Cantonments.</p> <p>It was not until 1929 that he was again able to get to the Indravatti and that was at end of April. He fished from Bomragarh for several days, trying all methods, without success. He had the impression that the river had been largely denuded of fish owing to extensive killing of all fish and fry in the upper waters of the river and its tributaries by the aboriginal inhabitants of Bastar State. During his stay the locals were unable to get any fish by means of cruives or other means.</p> <p>In 1924 a friend had lost a very big fish in the long, deep pool below the Bungalow. It was hooked on atta.</p> <p>Probably the season for the Indravatti River would be February and March, and again after the Monsoon. Fever would have to be guarded against.</p> <p><i>Pranhita R.</i> runs into the Godavari R. in the extreme South of the district and I have heard wonderful accounts of monster fish of 80 lbs. being seen, and tackle being broken.</p> <p>These waters have always remained a dream of mine and though I have planned to visit South Chanda twice I have never managed to do so.</p> <p><i>Wainganga R.</i> four marches from Chanda on the Sironcha road the fishing water is both above and below the cause way for about a mile. Fish of about 15 lbs. have been taken. In this District, in the South East corner, is a host of places; but they are very difficult</p>

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Chanda—(contd.)	Wainganga R.—(contd.)	to get at. Were it not for this the fishing would have lured the keen angler long ago and many a good bag would have been recorded.
Chhindwara.	Penchi R.	Penchi R. a tributary of the Wainganga rising in the hills South of Pachmarhi.
	Jilmilli.	Jilmilli 14 miles from Chhindwara on the Seoni Road is reported as having good water.
		Kundlai is a small village in the corner where the three districts of Chhindwara, Seoni and Nagpur meet, roughly 25 miles S. W. of Seoni.
		Khawasa about 30 miles from Seoni on Nagpur Road 12 miles West the River is crossed, and has good water. Bait with gram or atta for small fish of 5 lbs. or so.
		Alikutta is 6 miles upstream from Kundlai is mentioned as fishing well in the early part of the Season.
Damoh.	Bearma R.	Bearma R. Nohta, 52 miles on Jubbulpore road is a R. H. on the banks of the river. Best water a short mile up-stream. Best in the early part of the season water too low in the hot months.
	Ken R.	Ken R. the line to Katni crosses one of the main tributaries of the Ken about 30 miles from Damoh. Good at Ghat Piperia in the early part of the season. A good block for tiger with a nice F. R. H. overlooking the river.
	Sonar R.	Sonar R. Narsinghgarh, 10 miles North of Damoh. A large pool below a high bank on the right bank of the river from which big fish of 30 lbs. can be seen on occasions. The river is about half a mile N. W. from the R. H. The best time is early in the Season while the runs are still strong. Bait, gram and atta.
		Hatta, 22 miles by road to the North of Damoh is another place mentioned.
Hoshangabad.	Nerbudda R.	Two runs opposite the Judge's Bungalow. One well out in the River the other near the bank. The further one is the better of the two.
		Bandraban, 6 miles up-stream from the town, the Tawah joins the Nerbudda. Above this is good water. Bait atta or gram. Best season April/May, fish run to 10 lbs.
		Karraghat, the Ry. crosses the river two miles west of the town, this is good water, if runs are first baited with atta.



DISTRICT.	RIVER & TANKS.	REMARKS.
Hoshangabad— ( <i>contd.</i> )	Nerbudda R.—( <i>contd.</i> )	Nandpa, 20 miles S. W. of Hoshangabad is another good spot after baiting with atta.
		Gadarvada Stn. 72 miles East of Itarsi the line crosses the Shalkar R. a tributary of the Nerbudda R. Two or three good pools within 4 miles of the Station and one very good one half a mile above the bridge.
Pachmarhi.	Denwa R.	Denwa R. at Pachmarhi small fish have been taken in Oct. on fly spoon at Panzy-pool and Watersmeet. Above Matkuli is also mentioned as good water.
		Fullers Khud small fish can be taken on atta.
Jubbulpore.	Nerbudda R.	Nerbudda R. Bargi, 14 miles out on Seoni Road, the river is about two miles from the road. The Tamer joins in near here. Three runs worth fishing with gram.
		Bahoripar is 9 miles down the Seoni road where a track takes off, motorable in dry weather, about 1 mile distance. Cross the Ry. and the river is about 1 mile further on. Bait with gram before fishing.
		Guwarighat, 5 miles down Seoni Road. Runs are only a few hundred yards away. There is also some good water near the Ry. Bridge 2 miles up the river.
		Tilwarighat, 8 miles from the town or 3 miles below Guwarighat, has a good run and I have heard of good fish being taken on gram and atta.
		Lamheti is two miles further down, and has three good runs.
		Bheraghat, Notha 52 13 miles from Jubbulpore, has a R. H. run below Bungalow holds fish.
	Bearma R.	Bearma R. Notha 52 miles down the Damoh Road. Fishes best in Oct. after the rains, when good sport can be had with not only mahseer but Silund and Butchwa.
	Belkhund R.	Belkhund R. Dhanwani & Chugra. 33 miles from Jubbulpore. Follow Sehora-Khamtara Road to 5½ mile stone, and turn South along track to Chugra. Dhanwani is about a mile up-stream. Some nice pools and small runs.
	Gaur R.	Gaur R. Guraiyaghat, 5 miles out on Mandla Road, good fun can be had below the causeway in a fine spell during the rains or in October when the water clears.
		Kosamghat, 4 miles up-stream, has one or two nice pools, much fancied by Indian fishermen.
		Pararia, 1½ miles down-stream

DISTRICT.	RIVERS & TANKS.	REMARKS.
Jubbulpore—(contd.)	Gaur R.—(contd.)	has a small bund across the river which breaks up the water and is good after the rains for small fish. <i>Goorda R.</i> in the Seoni Road, looks a likely river, for small fish. <i>Hiran R.</i> Ganiari, Leave Jub-Damoh Road at 17½ milestone and take cart track for a couple of miles. Some nice runs and pools which hold good fish. Kakarhatta, 20½ miles down Damoh Road. Some four good runs here and ask for Mawah and Bandar Ghats, the two best places. A tributary of the Son and Ganges, which rises in Mandla, and joins the Katni R. North East of Katni town. Crossed by the Shahpura Road at mile 37, where the water looks good. Wasari, 16 miles East of Katni on the Barhi Road is the only place I know where it has been fished with success, but it is a fast flowing and rocky stream and must be good in a number of places. Fish will take spoon in this river besides atta and gram. <i>Temar R.</i> joins the Nerbudda near Bargi, and has fished well at times. Basanpani, Temar and Bargi all on the Seoni Road are favoured spots, but I have no details of sport. <i>Ganga R.</i> is crossed by the Burhampur-Edichpur Road 5 miles West of Dharni village and 2 miles from its junction with the Tapti. Dharni has a R. H. and P. O. and is 58 miles from Ellichpur. There is good fishing here and lots of good water for gram and atta. Tapti fish do not fancy spoon. <i>Katbi R.</i> is a tributary of the Ganga. Balkhund has a R. H. overlooking a big pool full of fish. It is 18 miles from Harisal on the Akot Road. When the river is high there is a fall into the pool and must be good. No details available. <i>Sipna R.</i> also feeds the Tapti joining it at Kegda a few miles N. E. of Dharni. Melghat, Best claims to have caught Mahseer with spoon, both large and small. Other places mentioned are Semadoh, Rakhidih, and Harisal. <i>Nerbudda R.</i> Dindori, 50 miles N. E. of Mandla is reported to have fished well. Sahasradhara is only three miles down-stream from Mandla where
	Goorda R.	
	Hiran R.	
	Mahanadi R.	
	Temar R.	
Khandwa.	Ganga R.	
	Katbi R.	
	Sipna R.	
Mandla.	Nerbudda R.	

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Mandla—(contd.)	Nerbudda R.—(contd.)	there is a nice fall at the head of a deep pool. Large fish have been hooked here. Imdhi, 6 miles from Mandla on the Jabulpore Road has a small fall at the head of a nice run which widens into a deep pool and holds big fish.
	Thanwar R.	Thanwar R. is a tributary of the Wainganga and is best approached from Padregung. I had a note years ago by a Ry. Official who caught some good fish of 20 lbs. and over and lost a lot of tackle in others. Fish take a spoon in the Wainganga system. See notes under Chhindwara.
Nagpur.	Penchi R. Wainganga R.	The river forms the border of the district in the E. with Bandara, there are some good fishing spots. Barhnan to the N. and where the Saugor Road crosses, there is some very nice water, and good sport has been had fishing with atta and gram.
Narsingpur.	Nerbudda R.	The Dharigha Falls: a grand place for fishing. Season after the S. W. Monsoon, as soon as the river begins to clear. Also March but then heat is very great. There is a basaltic barrier across the whole river, about 500 yds. wide at this point. The water falls in a series of cascades through passages worn in the rock. Fall of water level about 40 feet.
Nimar		Fish of all species in the river are here. Mahseer up to 20 lbs and more, large perrun and many murrel mugger. Live bait, and natural bait and spoon spinning, all successful, spoon least so, Plug not tried would probably do well. No accommodation on the South bank, a village on North bank (Dhar State) from which supplies and men can be had. Approach from Bir railway Station on G. I. P. Ry. via Punasa (F.R.H.) which is 6 miles from the Falls and 18 miles from Bir. Better to take men and supplies from Punasa with kind assistance of Forest Ranger. Boat necessary for access to further bank, and also to rocks in river. The South side of River is all Reserved Forest. 25 miles below is Mandhata where a number of boats. Many mahseer opposite the Temples on either bank. 7 miles below Mandhata is Road & Rail bridge over the river. Sta-

DISTRICTS.	RIVERS, TANKS & LAKES.	REMARKS.
Nimar—(contd.)		tion Mortakka. Good water below the bridge. Excellent runs for gram fishing. From Mortakka to Kalghat (by water) 40 miles; and from Kalghat to next place where motorable road touches the river 40 miles (by water): all this portion of the river should be good, but probably never fished by any angler. So also the next 90 miles all of which runs through hilly country. Must be any amount of good water and probably many rapids. Only way to fish the river from Mortakka to the furthest point would be by boat, and take some considerable 'bundobast', but worth it! Certainly never been fished by anyone.
Saugor.	Betwa R.	Almost the best river in the province as fish will take a spoon and run to a decent size, for further notes on this river see under Jhansi in U. P. section. Bina, there is some very good water near here, and fish run large. Kanjia, 15 miles from Bina. Approach <i>via</i> Mamboali on Bina-Goonna line. Make for Kanjia about 5 miles away. 1 mile below is a good run but it must be fished early, Oct. or the river shrinks and has not enough water in the hot months. Try spoon, atta and gram. <i>Bewas R.</i> crossed at the 12th mile on the Damoh Road, and at the 9th mile by the Narsingpur Road. There is good water at both places. Best in Oct. or in a break in the rains, when one may get into a good Silund. <i>Dhasan R.</i> the river is crossed 10 miles from Saugor on the Jahnsi Road. It fishes well after the rains and good fish have been taken 15 lbs. and over. See note under Jubbulpore. See under Chhindwara. Chhapara, 20 miles down the Jubbulpore Road there is a R. H. near the bridge. A good pool a mile down-stream with fish of 6 lbs.
	Bewas R.	
	Dhasan R.	
Seoni.	Goorda R. Pench R. Wainganga R.	

There was an Angling Association formed for the C. P. with its H. Q. at Jubbulpore, they published a Journal with a lot of useful information for the Resident or visiting Angler, but I cannot say if this is still functioning, I am talking of 1930-31.

Any one interested should try and obtain a copy of the Journal sold, I think for Rs. 2-8.

(Including Hyderabad State, Mysore State, Eastern and Western Ghats.)

# 8. MADRAS FISHING LOCALITIES ARRANGED BY PROVINCES.

## Hyderabad State.

Within this area, or forming part of its boundaries, are the *Godavary*, with its tributaries *Pranhita*, *Penganga*, and *Manjra*; and the *Kistna* with its tributaries *Bhima* and *Tungabhadra*.

All these great rivers hold Mahseer and sport is to be had with them wherever there are rocks and rapids by spinning, and in deep, still pools by bottom fishing: so also with other large carp and sporting fish of several species.

For very many miles on end portions of these rivers, such as the Godavari between Nander and Sironcha and from thence down to Rajahmundry; and the Kistna from a few miles below the G.I.P. Railway Bridge north of Raichur nearly all the way to Bezwada are almost unknown to the Angler. There are also long reaches unattractive to the angler because of alluvial soil and sluggish currents. This applies to almost all of the Manjra River. Where the Renganga and Godawari run through the northern jungles of Adilabad and nirmul those rivers offered good sport in many places.

Generally speaking the Kistna and its tributaries offered the best sport from early November when the waters begin to clear after the S. W. Monsoon, up to March or April. The Godavari and its tributaries do not fish well until somewhat later on account of the colder climate up to middle or end of January.

DISTRICT.	RIVERS, TANKS & LAKES.	REMARKS.
Hyderabad State.	Hussain Sagar & Mir Alam Lakes.	These large Lakes are stocked with all the usual species of Tank fish, and good sport can be had from the embankments. Information could be had as to baits and methods from a number of local Anglers, mostly Muhammadans.
	Kistna R.	Besides these two lakes there are many large artificial Lakes and Tanks throughout the State in all of which sport could be had. Kistna R. good water above the bridge for 3 miles and down-stream for a number of miles. There used to be a Bungalow, more or less unfurnished, at Devursugur 3 miles below the bridge on the right bank. Permission from the Tahsildar, Raichur. Officers of the Hyderabad Contingent had great sport in this part of the Kistna also in the Bhima (from Yadgiri) about fifty years ago. The fishing may still be good. 16 ft. fly rods and fly spoon were used, killing mahseer up to 40 lbs. and over. A portable collapsible boat is necessary. The

DISTRICTS.	RIVERS, TANKS & LAKES.	REMARKS.
Hyderabad State (contd.)	Kistna R.—(contd.)	7 ft. Berthen was found excellent. Suitable boats not locally available.
Yadgiri Stn.	Bhima R.	Half a mile from Railway Stn. good pool and runs. Mahseer up to 40 lbs. Portab boat essential for real success. No boats available locally. Accommodation in Station waiting room. The junction of the Bhima with Kistna is about four miles above the Ry. bridge, but is not attractive for fishing.

Except as above there are no detailed note available for the Rivers and Lakes of the Hyderabad State.

*Murrel*: Large fish of this species are to be found in a number of the deep, spacious, masonry wells in various parts of the country. They run to 10 lbs. in weight and it is surprising that more attention to the cultivation of this excellent table fish in this manner has not had more attention in many parts of India.

#### *Eastern Ghats.*

The *Sabari* and *Sileru* rivers, in the portions of them flowing within, or on the borders of the Jeypur state afford good mahseer fishing from early February on to end of May. The latter is the larger and better river with fish up to 30 lbs. These rivers are only accessible to the turing official or the sportsman on a shooting expedition. The mahseer take spoon.

The two rivers meet at the S. E. corner of the Bastar State and the combined river joins the Godavery 20 miles south, below Bhadrachallum.

DISTRICTS.	RIVERS, TANKS & LAKES.	REMARKS.
Jeypur State.	Sileru R.	<i>Sileru R.</i> the river has that name from the junction of the Machkund R. (always muddy) with the Gurpreo, R. (always clear.). Eight miles up the latter on the left bank is a Bungalow, Janwai. The junction is at Kondakambru where is also a Bungalow. There is a fine pool at the junction. From here to Konta where the river joins the Sabari is approximately 60 miles. First 45 miles through a valley with hills on either side and forest all the way. All the Game animals and birds. Many muggers. A few riparian hamlets. Malaria prevalent. No supplies. Trip can be done by means of dugout canoes which are available from Kondakambru. Allow ten to fifteen days. Remarks as for S. Kanara.
Malabar.	A number of streams; also Beypur. R. Palanted. R. and Head waters of Kabbani. R. flowing east.	

DISTRICTS.	RIVERS, TANKS & LAKES.	REMARKS.
Travancore State.		High Range. In this area are many Tea Estates. Some of the streams have been stocked with Rainbow Trout by the Planters Fishing Association which controls the fishing. Tributaries of the Periyar R., and of the Chalakudi. R. (Cochin State) hold mahseer.
"	Periyar Lake.	Holds big mahseer which are seldom caught. Sizable fish can be got from the Dam with plug bait. Area of Lake is 14 square miles, much of it studded with dead tree trunks. Very little water escapes below the Dam. There is a mile long tunnel taking water into the plains of Madura to east of the high hills in which the lake is situated. The Periyar river enters the lake in its eastern corner. Mahseer run up the river at time of the monsoons. When the river clears spoon fishing can be good. No access to the river except by boat and nothing can be done in the lake without a boat. The fishing in the Periyar area is controlled by the Vandiperiyar Planters Fishing Association.

#### Madras.

The fishable (hilly) portions of the Travancore and Cochin States rivers are less accessible than those of Malabar and South Kanara.

Most of the Travancore streams, even in their remotest parts, have been practically denuded of fish by gangs of poachers; this may also be the case with some of those further north in S. Kanara and Malabar.

The main mahseer rivers are the Godavery, Kistna, Tungabhadra, Cauvery, and Bhavani. Except as to the Bhavani no detailed notes are available.

Coimbatore.	Bhavani R.	<i>Bhavani R.</i> for full information see article by Lt.-Col. R. W. Burton in the <i>Journal of the Bombay Natural History Society</i> , vol. xli, 828. Season July and August and September and January February.
Salem.	Cauvery R.	<i>Cauvery R.</i> from the Sivasmudram Falls until it reaches the north corner of the Mettur Lake at the Hogenakal Falls, a distance of some 90 miles approached nowhere by motorable roads or even cart tracks, this portion of the river should afford fine sport and can have been seldom, if ever, fished by an angler for mahseer. The trip could be done with 2 coracles one for fishing, one for followers and supplies. All supplies

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Salem—(contd.)	Cauvery R.—(contd.)	would have to be taken, nothing available. Season from mid January to March. A good and adventurous trip well worth undertaking. Malarial precautions necessary. The mahseer would run large.
Godavari.	Godavari R.	<i>Godavari R.</i> this river is within the Madras Presidency or on its border from 30 miles below Sironcha until it flows into the Bay of Bengal near Coconada. There is good water where the river narrows below Bhadrachalam, and at a number of places where the river winds its way through the hills south of latitude 17.30 and 40 miles north of Rajahmundry. All this part of the river is known to only a few anglers who may have been serving in that part of the Presidency. No notes are available.
Kistna.	Kistna R.	<i>Kistna R.</i> from Kurnool to Bezawada the river is the Southern boundary of the Hyderabad State and northern boundary of Madras Presidency for 150 miles below Kurnool the river flows through a deep, jungle-clad gorge which has probably never been fished by an angler for mahseer. There are no roads or cart tracks. Many muggers. The trip could only be done by basket boat as for the Cauvery. Supplies would have to be taken. The heat would be great and the sport perhaps, phenomenal!
	Mettur Lake.	Season early November to March. <i>Mettur L.</i> formed in recent years by Hydro Electric Dam at Mettur. Lake 30 miles long varying in width from 5 miles at widest part Depth at the Dam and about 30/40 ft. at north corner where the Hogenakal Falls former 70 ft. high. Many large fish collect at this place. Half way up the lake the Palar R. comes in from the west.
Nilgiris.		Here follow notes from Mr. Madhavan Nilgiris. In this area are many streams, and a few artificial lakes, which have been stocked by the Nilgiri Game Association with Rainbow Trout. These streams are the head waters of the Bhavani and Moyar rivers. Some of the lower portions are open to coarse fishing but almost all is for fly fishing only.
	Neyar R.	All information from the Secretary of the Association at Ootacamund. <i>Neyar R.</i> forms boundary between Nilgiris and the Mysore State



DISTRICTS.	RIVERS & TANKS.	REMARKS.
Nilgiris—(contd.)	Neyyar R.—(contd.)	and runs in a thousand foot deep gorge known as the Mysore Ditch. Holds large mahseer and other carp but is seldom fished on account of malarial fever of a bad type and difficulty of access.
	Tungabhadra, R.	<i>Tungabhadra R.</i> borders the Madras Presidency from Harihar to Kurnool where it joins the Kistna R. Impending irrigation projects may affect the river. It is to be hoped that suitable fish ladders will be provided. The river holds large mahseer and has runs and rapids where sport should be good November to March. Distance from Harihar to Kurnool is about 250 miles and motorable roads give access at Hovanur, Hospet, Kampli, Siruguppa, Ramapuram; but it is not known if sport available within reasonable reach of those places. There is said to be malaria at Kampli. A portable boat would be essential. Supplies would have to be taken. From Hospet 12 miles is Balasanski district and 2 marches below is Sovainhulli—a Ferry here.
Mysore State.		In the north the <i>Tunga</i> and <i>Bhadra</i> rivers rise in the Western Ghats to flow eastwards and meet near Shimoga whence they form the Tungabhadra river. The Bhadra is the better fishing river and affords good sport to the Coffee Estate Planters of the area. Mahseer run to over 30 lbs. Further north is the <i>Sharavati</i> river which makes its way via the Gersoppa Falls (830 ft.) to the Arabian Sea. It holds mahseer up to at least 20 lbs. Recent Hydro-Electric works may have affected the fishing above the Falls. To the south the <i>Cauvery</i> river, its sources in the mountains of Coorg, having added to its waters many streams rising in the Western Ghats, leaves the State 30 miles below the Sivasamudram Falls. It is joined by its largest affluent, the <i>Kabbani</i> River, a few miles below Mysore City. Mahseer in the Cauvery and Kabbani run to over 100 lbs.* The

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\* In May 1946 Mr. Van Ingen caught one of 120 lbs.

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Mysore State—(contd.)		record fish for India (119 lbs.) came from the Cauvery some 14 miles below Mysore City and the next largest (110 lbs.) from the Kabbani in its higher reaches. These large fish are mostly taken on balls of ragi paste. Where there are rocks and rapids fish up to 40/50 lbs. have been taken on spoon; but other large mahseer have been caught on both live and dead bait, and on spoons.
	Lakes.	The <i>Krishnarajasagara Lake</i> formed by a Dam across the Cauvery 11 miles above Seringapatam holds many monster mahseer which are very difficult to catch in such a deep and extensive sheet of water. The <i>Vanivilas Sagar</i> is another large Lake. It is west of Hiriyr and a hundred miles north west of Bangalore. There are other large Lakes and Tanks in all of which use of portable boats is essential to success. The State is well served by a number of motorable and other road giving access to the lakes and rivers of the country.

## AVAILABILITY OF GAME FISHING FACILITIES IN MYSORE STATE.

(Information supplied by the Fisheries Office, Mysore State).

DISTRICT.	RIVERS, LAKES, OR PLACE.	REMARKS.
Mysore State.	Cauvery R.	<i>Cauvery R.</i> Seringapatam 10 miles from Mysore and 78 miles from Bangalore reached by rail and motorable road. A good T. B. with servants is available. Surrounding Seringapatam are a few good pools for Mahseer and other carps. Doddinamadu on the 4th mile stone from Seringapatam on the way to Bluff. Two pools here are famous as containing record size Mahseers. Coracles are available. Bommanathittu, 5 miles from Seringapatam up-stream, on the way to Krishnarajasagar reservoir. Close by is a Bird Sanctuary and the pools within about 2 miles are good for Mahseer, Labeo, Carnatic carp and <i>Barbus dubius</i> . Usually baiting is practised in this spot. Coracle is available. Mudukthore, this place is 28 miles from Mysore on the way to Bluff or Shivasamudram. There is a small T. B. in Talkad, 2 miles below along the river course. The large pool formed above the weir

DISTRICTS. RIVERS & TANKS.  
Mysore State—(contd.) Cauvery R.—(contd.)

## REMARKS.

offers a very good baiting for Mahseer and other carps. Area covered by the pool is more than 4 miles along the river. Boats are essential though coracles may be made available.

Shivasamudram or Bluff, this is where the Cauvery leaves the Mysore plateau by means of two falls. Hydro-electric power generating station is situated close by and the place can be reached both from Bangalore and Mysore by road, or up to Maddur by rail and thence by bus. Spinning may be done in the rapids above. Pools below the falls contain good catfishes like *Silundia* *Mystus aor*, and Mahseers. A collapsible boat will be essential in the pools and rapids below.

Mekedatu. This is perhaps the most unfrequented fishing spot comparatively unknown to the anglers. It is reached via Kankanahalli, 30 miles from Bangalore by road and another 22 miles from Kankanahalli by road. A total of 52 miles negotiable during hot months only. Otherwise the motor road from Bangalore to Channarayana on the Mysore road has to be used and the road to Satnur and Aladahalli a distance of about 62 miles has to be covered from Bangalore. There is a small T. B. and coracles are available. The rapids and the large pools contain record size Mahseers. From what has been gathered from the local fishermen, it is evident that the large pools and the rapids have very old and large inhabitants more particularly mahseers and catfishes. Coracle is available. Both spinning and baiting may be practised very successfully.

Krishnarajasagar  
Lake.

Krishnarajasagar, the lake is formed by a large dam across the Cauvery. It is reached from Mysore either by train or by road, (12 miles). Good Travellers' bungalow available as well as a European Hotel run by the Government of Mysore. Angling is good only in the rapids below the dam in the waste-weir and the river course. Baiting may be done on the quieter pools along the river or in the reservoir itself. Rapids below offer good spinning. But the reservoir itself is not very good as it is too deep and game fishing is not tried successfully on it so far. Two miles below in a pool formed by another small

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Mysore State—(contd.)	Krishnarajasagar Lake—(contd.)	weir across the river good angling for Mahseer as well as other carps and some catfishes like Wallago is available. The back washes of the reservoir in the river course near about Krishnarajnagar 18 miles by rail, and 22 miles by road, baiting may be practised successfully for Mahseer, Labeo, Carnatic carp etc. Boats are available and coracles may also be arranged. <i>Krishnaraj nagar</i> is two miles from the angling grounds possessing a good T. B. with servants.
	Kabbani R.	Chunchankatte, 10 miles from Krishnarajnagar, this can be reached by a motorable road. A small T. B. is available. The rapids and pools below the weir are good for spinning and baiting and very good Mahseer may be had at all times. 6 miles above along the road is another place, Hansoge which is also good for angling and could be visited from Chunchankatte. 25 miles from Krishnarajnagar and about 16 miles from this place is Ramanathpur where a Temple Sanctuary is interesting as it shelters almost all the carps of the Cauvery. They are accustomed to human company and are very tame. Fishes ranging up to 80 lbs. (Mahseers) are seen in the pool. Angling of any kind is prohibited for about a mile surrounding this area. There is a good T. B. also in this place.
Shimoga	Thunga and the Bhadra.	Kakankote. 48 miles from Mysore. Very good mahseer is available surrounding this area. The pools are 'palace game preserves'. Other pools not set apart are also good and may be tried successfully as the Kabbani teems with large mahseer. The river 12 miles below may be tried in the deeper pools near about Sargur. There is a good T. B. in Heggadadevankote, about 15 miles from Kakankote downstream. The pools from Heggadadevankote are between 6 to 8 miles and are reached by roads. Probably the good fishing season in this area is between October and December when mahseers breed in the pools of these head waters of the Kabbani.
		Shimoga. This town is reached by rail from Bangalore towards the northwest of the State. Also a good road from Bangalore up to Honnavar in North Canara which passes through Shimoga. Sacrebyle, 9

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Shimoga—(contd.)	Thunga and the Bhadra—(contd.)	miles from Shimoga has good number of pools and abounds in mahseer, <i>Barbus neilli</i> , <i>Labeo jimbriatus</i> and several catfishes like <i>Mystus aor</i> , <i>Pseudotropius</i> , <i>Bagarius</i> . A Small T. B. available at Sacrebyle (as well as a good T. B. in Shimoga itself provided with servants). Other pools along the river may be tried near about Sacrebyle and a collapsible boat may be very useful as there are no locally available coracles or boats. Occasionally an eel or two are also hauled.
	Thungabhadra R.	Honnali, 24 miles from Shimoga by road possesses a few good pools where mahseer, <i>B. neilli</i> and other carps and catfishes may be successfully angled for. There is a good T. B. here on the bank of the river.
	Sharavathi R.	North-west of Shimoga District is this drainage which is almost unknown for anglers. Mahseers, and other carps like <i>B. neilli</i> and <i>Labeos</i> are available. The camping facilities available are at Gersoppa or Jog Falls itself which is going to become a Hydro-electric generating station. There are good travellers' bungalows for staying and angling may be tried both above the Falls and below. A collapsible boat is very essential. Talguppa has a good T. B., 12 miles from Jog Falls and could be reached from pools of the river, 5 miles distance by good motorable road. Angling has not been tried here properly by anyone though the local records show the occurrence of game fishes in large numbers.
	Sulekere Tank.	<i>Sulekere Tank</i> . 26 miles from Bhadravathi and 36 miles from Shimoga by road, this place has a good T. B. and angling for small carps up to 12 lbs. as well as catfishes up to 30 lbs. may be done profitably. There is no facility for boats or coracles nearby. Lot of butterfish ( <i>Callichrous</i> ) and occasional eel offer good variety.
Chitaldrug.	Vanivilas Sagar.	<i>Vanivilas Sagar</i> :—102 miles from Bangalore in Bangalore—Bellary road, turning west at Hiriyur. There is a good T. B. and an Inspection Lodge. This large lake is not very well stocked with good varieties of fish and it is not placed very conveniently for an angler. This lake is the second biggest in Mysore. There is good boating and a steam launch. Mahseers, <i>B. neilli</i> are recorded occasionally and several large catfishes and carps up

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Western Ghats.		to 15 lbs. are usually common. Eels are also caught now and then.
		All rivers having sources in the Western Ghats and flowing westwards into the Arabian Sea hold mahseer in their hilly portions. Ordinarily size will not be above 15 lbs. Except where within reach of motorable roads the streams are not easy to get at. Apart from such notes as are available and given below, the interested angler can obtain information as to roads, accommodation, and rivers from the Road Map of India, and Survey of India Maps.
		'The Rod in India' by H. S. Thomas, 2nd Edition, 1881; and 'The Mighty Mahseer' by Skene Dhu, 1906; should also be referred to.
		Mahseer in all these rivers take spoon bait, in some of them they will accept no other bait, and in some they will take fly.
		In some of the streams the less glittering spoons of frosted silver finish do better than ordinary bright spoons.
South Kanara.	Holadi. R.	<i>Holadi</i> R. this river may be fishable from the Hulikal-Hosangadi road which runs parallel, and a few miles from it, after it leaves the Mysore State. No information is available.
(for N. Kanara see under Bombay).	Sitanadi R.	<i>Sitanadi</i> R. is crossed by the Agumbi Ghat road (motorable, Buses ply) between Someshwar and Hebri east and south of which is another stream.
	Swarnanadi R.	<i>Swarnanadi</i> R. crossed by the Hobri-Karkal road and in its upper reaches by minor roads at Mala and Miyar.
	Gurpur R.	No information is available. <i>Gurpur</i> R. crossed in several places, Yenur, Marur and, to the north Naravi, by major and minor roads.
	Natravati R.	No information is available. <i>Natravati</i> R. enter sea at Mangalore. Has a number of large hill tributaries. A large tributary with many hill streams joins the main river at Uppinangadi. On the northern streams are Charmadi and Neriya mentioned by Thomas (the former on the Mudgiri—Mangalore Ghat road) and on the eastern stream is Shisla, accessible by cart track (3 miles) from Shiradi.
		The other main tributary also joins in at Uppinangadi. It is the Kamaradhari and has two branches.

DISTRICTS. RIVERS & TANKS.  
 South Kanara—(contd.) Natravati R.  
 —(contd.)

## REMARKS.

The Gundayable comes from near Manjarabad and has the Hassan-Sakleshpur-Mangalore Ghat road alongside it for about 20 miles. Buses run. Stay night at Manjarabad Club (road branches here for bisole on upper reaches of Kamaradhari which can also be got at from where the above mentioned ghat road joins with it 20 miles below Shoradi.) next day take bus and go stay Kumphulla, D.B. Fish accessible parts of river from there. Then go Gungaya where is old Forest Shed now used as a cow shed. Camp. Five miles further down is Shiradi, L.F.R.H. at mile 53 from Mangalore. Good spot 1 mile above bungalow also below. Four miles from bungalow cart track for Shisla turns off to the right. Nowhere to stay, river full of fish. Period for these waters middle September onwards. Malaria precautions necessary.

See also Notes by Skene Dhu at pages 219 & 220 of his book.

Payaswani R.

Good looking water at Sulya which is 33 from Mercara and 52 from Mangalore on the Ghat road between these places. At Sulya from F.R.H. and from here towards Mercara the road runs within reach of the river for about 20 miles. No information available but fishing should be good. 5 miles up and down available at Sulya.

add. A. F. R. H? at  
 Parappa down-stream  
 about 4 miles from  
 Jalsur. Malaria.

General remarks as for South Kanara.

Malabar.  
 (See also p. 236)

Vallarattanam, R.  
 Beypur R.  
 Palanted R. &  
 Head waters of  
 Kabani R. flowing  
 East.

The Vallarattanam R. becomes, higher up, the Vallyapuzha which rises in Coorg.

A F.R.H. at Makut inside Coorg and a P.W.D. Bungalow at Kutupoya in Malabar. These only two miles apart. Other side of river from Kutupoya is Portland Rubber Estate. Ghat road runs for eight miles within reach of the river until Iritti where it is joined by the Aralam Puzha, a large stream with many hilly affluents. 4 miles up stream village Aralam.

Beypur R.

Beypur R. Upper reaches fanning out in the valleys are accessible in some places from the Calicut-Gudalur road. Mahseer up to 15 lbs.

# 9. PUNJAB AND NORTH WEST FRONTIER PROVINCE AND BALUCHISTAN.

Abbotabad.

Siran R.

Siran R. From Harriapur Station, then 7 miles to Thapla fishing is good from the junction of the

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Abbotabad—(contd.)	Siran R.—(contd.)	Dore with Siren down to junction with Indus. Bala is another good place.
	Kalapani R.	<i>Kalapani R.</i> Was stocked with trout (fario) years ago, but have since disappeared I understand.
	Dore R.	<i>Dore R.</i> Crossed near Sultanpore on Hassan-Abdul-Abbotabad road by a large bridge, but is a poor stream with very small fish.
Ambala.	Jumna R.	<i>Jumna R.</i> The only water is at the Head works of the Jumna Canal at Tajuwallah, and Dadupore. Served with a good motor road, or by railway to Jagadri station 12 miles away. The canal falls all hold Mahseer as far down as Karnal.
	Rakni R.	<i>Rakni R.</i> Approached by Frontier road from D. G. Khan to Peshin, through Loralai. Best water between Mat and Rakni.
Baluchistan.	Anambar R.	<i>Anambar R.</i> The best fishing is between Shadiani and Missi and Misri kach 20 miles from Loralai.
	Bolan R.	<i>Bolan R.</i> Train to Sibi or Nari bank and make for Kirth Rest House or Wundalami R. H. an easy ride, Fish are all Mahseer under 15 lbs.
	Kurrum R.	<i>Kurrum R.</i> Near Bannu and below the Kurrum Post small fish of 2 and 3 lbs. can be caught, but the best fishing is in the upper reaches above Thal extending up to Parchinar where fish of 5 and 6 lbs. have been caught.
Bannu.	Tochi R.	<i>Tochi R.</i> Good sport can be had with small Mahseer near Saidgi and Shinki, I have caught them as high as Edak but it is unfriendly country and hardly worth the risk unless under pickets.
	Hurroo R.	<i>Hurroo R.</i> Mahseer are to be had in some good rapids 10 miles out, but the best fishing is at the junction with the Indus.
Campbellpore	Kabul R.	The Kabul R. also join the Indus near here and is reported to hold larger fish.
	Sutlej R.	<i>Sutlej R.</i> Sluices & pool below Sutlej Dam on Ferozepore-Lahore road (6 m. from Ferozepore & 44 from Lahore).
Ferozepore.		<i>Butchwa</i> on fly (jungle cock & silver) or any lake size fly with silver tinsel about it, also small fly-spoon.
		<i>Mulley.</i> not uncommon and frequently taken.
		<i>Seetul,</i> large numbers are seen and some are caught when trolling big pools below the bridge dam.



DISTRICTS.	RIVERS & TANKS.	REMARKS.
Ferozepore—(contd.)		<p><i>Mahseer</i> are present. No information as to size there is an excellent fish-ladder. Plenty of rohu and other fish many turtle and a few garial.</p> <p>For all the fishing boat almost essential and can be readily obtained from local fishermen.</p> <p>See under Tangrote.</p> <p>Trout are to be had but the subject has been dealt with so thoroughly in books already in print that it is unnecessary to enumerate the rivers and localities here. A book on the rules with general information is published by the State and is obtainable for 8 annas. There are besides a number of agencies who make all arrangements for the new comer.</p> <p>Small <i>Mahseer</i> may be had near Dobah and below.</p> <p>To the intending visitor to Kulu no better guide than T. Tyson's book 'Fishing in Kulu' could be recommended. It is published by the Civil and Military Gazette Lahore. It has maps and all the information necessary.</p> <p>Butchwa and the commoner fishes can be had near the Bridges. For <i>mahseer</i>, journeys must be made to one of the many places listed.</p> <p>A number of tanks have been stocked with <i>Labeo</i> by Government for information apply to the Director of Fisheries, who will give up to date information.</p> <p>See note under Baluchistan.</p> <p>This river can be reached in two easy marches.</p> <p>Distance 24 miles to Dhalkot via Thanda. It joins the Jhelum at this point, much up-stream it is indifferent fishing with small fish. When the Jhelum is in flood and banks up the mouth of the Mahl big fish are to be had by both spinning and on frog. See further notes on this river under Tangrot.</p> <p>Madhojur 8 miles away is at the Headworks of the Lower Bari Dhob Canal off the Ravi R. best fishing is above the wier.</p> <p>28 miles from Cantonments is Fort Abazai, built on the river. Good fish are recorded from here, in the 'Anglers Hand Book' but times may have changed.</p> <p>See under Balauchistan.</p> <p>All within easy reach of Cantonments, and were once protected by a Fishing Club, local information is necessary or if the Club log book</p>
Jhelum. Kashmir.	Jhelum R.	
Kohat.	Toi R.	
Kulu.	Bias R.	
Lahore.	Ravi R.	
	Tanks.	
Loralai. Murree.	Rakni R. Mahl R.	
Pathankote.	Ravi R.	
Peshawar.	Swat R.	
Quetta. Rawal-Pindi.	Bolan R. Sohan R. Korung & Chiblat R.	

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Sialkote.		is available reference to notes therein will be of help.
	Chenab R.	The Chenab takes in two or three streams, the junctions of which are all reported to be good. Trolling in the deep pools has also met with success. The Jammu-Tewari? Bhab-Nala? and Khano Bhao Nala.
Simla Hills.	Giri R.	This river can be reached from Solan, from where it is 10 miles to the junction of Giri and Ashai stream, or from Salogra Ry. Stn. only 7 miles from the same junction. If planning a long holiday—Fish from here to the junction, with the Jumna about 50 miles of good fishing water, with innumerable tributaries joining in.
	Sutlej R.	This river runs north of Simla, and provides power and water and is an easy days march. For details of good fishing places local enquiries should be made.
	Bias R.	On the road to Kulu and in Mandi State some of the streams are stocked with trout. For details see under Kulu.
Tangrote.	Jhelum & Poonch.	This is probably the most celebrated spot for fishing in the Punjab and needs little introduction. It is reached from Dina Ry. Stn. then by road 16 miles or from Jhelum 23 miles by road or river. The Bungalow has a Visitors Fishing Book full of most interesting notes. Trips from Poonch can also be undertaken and are an interesting and popular approach.

This concludes these brief notes on fishing in the Punjab, there are of course scores of other places about which little is written or known, except to a select few who guard them as secret.

#### 10. UNITED PROVINCES AND DELHI.

Allahabad.	Jumna & Ganges.	All the commoner fish are to be taken, Butchwa, Silund, and W. Attu, etc.
		The Jumna has much the best water of these two sacred rivers at this revered junction. It carries the greater volume of water being fed by the Central Indian Rivers. The best places to fish for Butchwa are undoubtedly around the piers of the Railway Bridge in the broken water, and in the swirls near the banks from the water works down to the Junction. The best time is from 10 a.m. to 4 p.m. when the water is clear, and at the changing of the seasons, and hot weather.

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Allahabad—(contd.)	Jumna and Ganges —(contd.)	<i>Bait.</i> Fly-spoon, Fly, Mole cricket or small fish will all take Butchwa, but for Silund a slowly spun bait 4 to 6 inches long is the best, or a 'Plug' may be successful. The Ganges is indifferent, though fish are visible near the Railway Bridge. It has very little water in the best Season, being drained for irrigation by Canals.
	Tons.	Small Mahseer are taken on Fly-spoon both below and above the bridge on the Rewa Road from two to four miles. Best season is after the Rains when the river clears, fish up to 10 lbs. have been caught. Fishing is good from Lohaa to Korhar about 16 miles of water.
	MacPherson Lakes.	These lakes are in the Cantonments and are well stocked with Labeo, Catla, and Mirgil. Evidence of their popularity is seen by the number of Machans erected. Fishing permits are issued by the E.O. and the Chowkidar will erect a Machan for Rs. 10/-. A Book of catches is kept by the Chowkidar and makes interesting reading. Fish are caught all the year round, the best bags are registered in September and October and part of November: Catla of 60 lbs. have been taken and Rohu of over 30 lbs. There are also tanks within a radius of 20 miles of the town, that fish well.
	Balan R.	A small river in the South of the District holds small Mahseer and B. Bola. Take road to Kuraon then follow the Mirzapur road to where it crosses. Good water to Mando village down stream. This is from a friend. The Balan also fishes well in the Mirzapur district. Places mentioned in the Anglers Handbook are Buroundeth 25 miles down the Rewa Road a P.W.D. Bungalow, also a bridge. The River is 300 yards away, and fishing is good to Kool-sara.
Almora.	Kosi R.	The Kosi is crossed on the way from Ranikhet, but it is a small stream here and the best fishing is lower down and above Kairhna, though it is not really good until it enters Reserve Forest one march below Kairhna, from here down to where it comes out of the hills is all good. Further west is the W. Ramgunga an excellent river and easily approached from Ranikhet,

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Almora—(contd.)	Kosi R.—(contd.)	or from Ramnagar on the O & T. Railway. But for the best fishing in this District we must look East to the Surju and East Ramgunga. The water from Kapkot (D. B. Bungalow) 14 miles above Bagashwar on the Pindari Glacier road to two marches from Almora down to Rameshwar where it joins the Ramganga is all good water and fairly well provided with Rest Houses. There are some imposing Gorges along this stretch of river, and fishing is somewhat restricted, though they are worth any amount of trouble as they hold huge fish of 50 and 60 lbs. Kit must be carried by coolie, as the pony track leaves the river in places, and good water is missed out. Bait. This is a chilwa or dead bait river, and gives far better results than spoon, except for the light work with Fly-spoon. The best water is lower down and I would recommend making for Upper Shera Ghat 29 miles from Almora. From here down to Rameshwar is all good water taking in the R. Ramganga here it flows on for another 6 miles to join the Kali at Pachashwar, making a wonderful junction and which I think is the best water in Kumaon. There are monster fish here and it is not unusual to be running fish all day. The best time is March and April, May is a bit late, besides it gets oppressively hot. This river is still further East and runs on a parallel course, more or less from Tajam to Rameshwar with the Surju. It is a river of deep un-approachable gorges, which has to be approached in certain portions and only after long marches and much climbing. It can be approached (1) by crossing the Samapass above Kapkot, and working down the river to Rameshwar to the Junction with the Surju. I have done it once, but it proved more an adventure than successful fishing. A boat to work down through these gorges would be an experience well worth trying, there is certainly no other way of doing it. It holds enormous fish, (I have a belly scale of a fish I foul-hooked in this river that is the size of the palm of the
	Surju R.	
	East Ramgunga.	

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Almora—(contd.)	Gori R.	hand). It is a much faster and larger river than the Surju. Still further East is the Gori a raging torrent almost all the way down to its junction with the Kali. It offers wild scenery and good shooting, but has proved a disappointing river to fish for mahseer. I feel sure it would, with its many feeders, make an excellent Trout river.
	Gonah Lake.	Is not in the Almora District but in Tehri Garhwal. One of the easiest ways to it is from Almora so I have included it here. It has an abundance of trout, and the angler is amply repaid for the long and arduous 'trek' of getting there in 7 or 8 marches.
	Sarda R.	Katarnian Ghat on O & T. Railway is on the bank of the River fish have been taken both above to the Nepal frontier and also a few miles down, small Mahseer and B. Bola. The best fishing is to be had in Nepal to a place called Chisapani 32 miles inside. But for this, special permission must first be obtained and this is not easy. The arrangements for getting supplies and transport are a further difficulty, as it is wild country with very poor roads.
Baraich.	Surju & Rapti.	These two rivers in the North East of the District should be good but the best water is in Nepal.
Benares.	Ganges R.	Butchwa and other predacious fish can sometimes be caught by the keen angler near the Pontoon and Railway Bridge, or if one wishes to catch the foul feeders, the outlet of the sewage drain below the Railway Bridge worm will provide 'sport'.
	Tanks.	The Benares State have some nice tanks well stocked with Rohu, but permission must be obtained. There is also a very pretty Bungalow at the Reservoir at Naini 20 miles out, below the dam is a pool full of elusive fish which is protected by the State. It would be well worth a visit in October after the water had cleared or after baiting with gram.
Dehra Dun.	Ganges. Song & Suswa & Asan Rivers.	All but the first named are protected for part of their length by the D.D. Fishing Association from whose books full details can be obtained. The Ganges is best at Lachmanjhoola, Rikkikash, Tajuwallah? and at Hardwar, but care must be taken to avoid Temples and Sacred ghats etc. in order to avoid any chance of unpleasantness.

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Dehra Dun—(contd.)	Ganges Canal.	This information could be obtained from the Collector of Dehra Dun or the local Canal Authorities.
		The falls below Hardwar are at approximately 3-mile intervals, and fish well at times, I have had excellent sport at Patri Falls. A key for the road gates must be obtained from the R.E. in charge, who is as often as not himself a fisherman and would be helpful if called upon.
		The falls used to fish well as far as Delhi but the Hydro Electric grids have spoilt falls from an Anglers point of view.
	Jumna R.	Jumna R. In the west of the Doon is the Jumna, and with the Asun affords good fishing. Full details are obtainable locally and through the Association.
Delhi.	Jumna R.	Jumna R. At Okhla-14 miles excellent fishing can be had with Mahseer and the predacious fish, when a fish run is on and the small fish have collected. Silund if on the feed will give grand sport. Some good sport has been had at the overflow. It is necessary to have someone on the spot to send information of the fish running, generally just before and after the Monsoon.
	Ganges Canal.	Ganges Canal. The falls at Dashna were good but are probably spoilt, with those in the Meerut District, by the many grids erected.
	Roshnara Tank.	Roshnara Tank is well stocked with Rohu and is well known. There are besides a number of old tanks in and around the old City.
Gorakhpore.	Gandak R.	This river borders on the East of the District and although the Malars at Tirbhani catch fish of 20 lbs. and over, I have only heard of small Mahseer being taken on spinning bait. There are few rapids and it has been little tried.
	Tanks.	A poor station from the Anglers' point of view, though there are a few tanks which hold <i>Labeo</i> . Butchwa can be had in the small streams draining the District at pontoon bridges, junctions etc. while the large lakes hold Murrel in large quantities.
Hardwar. Jhansi.	Ganges	See under Dehra Dun.
	Betwa R.	Betwa R. Mahseer and trout (B. Bola) can be had down the Nowgong Road. 7½ miles from Jhansi. Paricha 15 miles down the Cawnpore road is probably the best water near at hand. There are other places but off the beaten track and at greater distances. Other

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Jhansi—(contd.)	Betwa R.—(contd.)	small streams worth a trial with light tackle during or just after the Monsoon are the Barbari, Pahuj, and Dhurari Nallahas, all within easy reach of the town and served by good roads.
	Burwa Sagar Tank.	<i>Burwa Sagar Tank</i> 13 miles out affords the tank angler with all he desires.
Landsdowne.	Nayar R.	<i>Nayar R.</i> A tributary of the Ganges. Rail to Kotdwara and make for Bang-Ghat 29 miles where there is good water all the way down to the junction, fish of 30 lbs. have been taken.
Lucknow.	Gomti R.	<i>Gomti R.</i> Lucknow has no fishing to write about except perhaps a few butchwa in the Gomti and Rohu in tanks dotted about, but it is well situated, and one can get to good water in a nights journey.—The Sarda at Tanakhpore, the Girwa at Kauriala on O & T. Railway, Betwa at Jhansi.
Meerut.	Ganges Canal.	The canal has a number of falls at easy distance from Cannt. (see remarks under Delhi) Fishing with atta paste at the cattle crossings and drinking places sometimes provides good sport.
	Hinden R.	<i>Hinden River</i> is very popular with Indian Anglers who get good fish of the pariah types, but details are lacking.
	Tanks.	The only tank I know of is $7\frac{1}{2}$ miles out on the Hapur Road, it holds <i>Labeo</i> .
Naini Tal.	Gola, & Kosi. R.	The <i>Gola</i> at Ranibagh, and <i>Kosi</i> at Kairhna and below both give sport if hit off at the right time.
	Nandhaur R.	<i>Nandhaur R.</i> Runs through Reserved Forest it is situated 12 miles East of Haldwani on O & T. Ry. It is connected by motor road, and has F. R. Houses. The best fishing is above, where fish of 10 pounds or more can be had on fly-spoon. Camp at a chowki called Selakul 5 miles from Chorgalia. Best seasons are Feb/March and after the rains.
	Lakes.	The lakes at Sathtal Naukatia and Bhimtal are well known, and easy to get to from either Naini Tal or Bhowali.
		It is pretty fishing with fly, the fish seldom run above two lbs. and are poor fighters. Kurpa Tal on the Kaladungi Road is also worth a trial, but Nainital is disappointing, and the fish are dying off yearly.
Philibhit.	Sarda R.	<i>Sarda R.</i> Tanakhpore is within easy reach, and has some good water above and up to the Puni-

DISTRICTS.	RIVERS & TANKS.	REMARKS.
		gari gorge above the Boom at Barhamdfo. Opposite the Forest Rest H. and down to Bombasa if fishes well in the hot months and before the snow water comes down.
		The canal itself should hold fish though I have no first hand information of anyone fishing it or catching anything.
Saharanpore.	Jumna R.	<i>Jumna R.</i> There is good fishing to be had in the North of the District, in the many streams that flow into the Jumna, or Ganges. Notes and Names of places are not available to include here.
Tanakhpore.	Ladhya R.	<i>Ladhya R.</i> Though in the Almora District, it is best approached from Tanakpore, 7 miles up the Loharghat Road, the Ladhya is crossed at Chalti. From here to its junction with the Sarda at Chuka—a distance of 14 miles—is all excellent water for B. Bola and Mahseer up to 15 pounds. Best season is Oct/Nov. or just after the monsoon.

## THE EARLY STAGES OF INDIAN LEPIDOPTERA.

BY

D. G. SEVASTOPULO, F.R.E.S.

## PART XV.

(Continued from Vol. xlii, p. 69.)

## RHOPALOCERA.

## PIERIDAE.

*Delias berinda* Moore, *boyleae* Btlr.

I can find no constant difference between the pupa of this subspecies and that of the nominotypical one (1941, mihi, *Journ. Bomb. Nat. Hist. Soc.*, xlii, 748). A few had a broad white marginal band on the wing cases, leaving only a submarginal olive-brown blotch between it and the central white triangular mark.

Pupa usually found in small groups of seven or eight on the upperside of twigs or leaves of medium height bushes. Presumably the larvae drop from their food-plant and spin up below.

Described from a number of pupae found at Tukdah (5,000 ft.



Darjeeling District) 10-v-44, from one of which a male emerged 14-v-44.

#### DANAIDAE.

*Euploea mulciber* Cr., *mulciber*.

Moore, *Lep. Ind.*, i, 100, pl. 35, fig. 1. 1890-92.

Bingham, *Fauna Brit. Ind.*, Butterflies, i, 45. 1905.

1st instar.—Head black. Body greenish yellow with faint grey transverse stripes. Legs and prolegs black. Tentaculæ indicated by raised blackish dots.

Half grown larva.—Head black. 1st somite with a subdorsal black spot. Body white transversely banded with olive, anterior and posterior somites and a lateral stripe yellow. 2nd, 3rd, 5th and 11th somites with short subdorsal tentaculæ. Legs and prolegs black.

Final instar.—Head black with two white rings, the inner one triangular. 1st somite yellow with a purple black transverse band. 2nd to 11th somites white with two transverse black bands on each somite ending above the spiracles, the posterior band edged behind with purplish, which continues to the sublateral area, and two fine black lines between each somite. An interrupted orange spiracular stripe, below which is a series of triangular white spots. A purple black sublateral stripe. 12th somite tinged with orange posteriorly. Venter purplish with a purple black lateral stripe. Legs black. Prolegs black ringed with yellowish olive. Anal flap and claspers black. 2nd, 3rd, 5th and 11th somites with subdorsal tentaculæ, purple at base and blackish above, the anterior two pairs longest.

Pupa suspended by the cremaster. Brilliantly gilded except a ventral streak below the head, the antenna sheaths, a discal streak and marginal band on the wing cases, the median portion of the thorax, a dorsal band on the 4th abdominal somite and a subdorsal and lateral stripe on the abdomen, which are purple buff. Anal somite and cremaster black. Shape rounded, the thorax and abdomen domed.

Described from larvae found at Tukdah (5,000 ft. Darjeeling District), one of which pupated 18-vi-44 and a male emerged 30-vi-44.

Bingham quotes the following description by Moore:—'Larva cylindrical, with four pairs of long fleshy subdorsal filaments which have pink bases and black tips, three pairs being on the anterior segments and the fourth pair on the 12th segment. Body pinkish white with lateral yellow blotches, the segments each divided by a black line and anteriorly bordered by a narrow transverse pink band and purple-brown stripes; spiracles black; head with a dark red stripe in front and one on each side; fore legs black, middle and hind legs black ringed with pink. (Larva of the Javan form, *E. claudia*.) Pupa short, thick across the middle; thorax concave behind; abdominal segments dorsally convex, metallic golden-brown with darker brown anterior stripe.'

## SATYRIDAE.

*Lethe rohria* F., *rohria*.

1st instar—Head yellow green, slightly bifid above, with a few black hairs. Body bluer green, the secondary segmental divisions whitish, a few black hairs visible under a lens. Anal somite bifid.

2nd instar—Head green, rounded and surmounted above by two points close together, and clothed with black pubescence. Body green, under a lens covered with minute white points and colourless pubescence. Anal somite divided into two pink processes.

3rd instar—Similar. The cephalic points pink. Body bluer green with a dark dorsal stripe and a white subdorsal line. Anal somite produced into a triangular point, the apex bifid.

4th instar—Head green, heart-shaped, the apex pink and slightly bifid, a yellowish line posteriorly joining the subdorsal body stripe. Body blue green, a bluish dorsal stripe edged with whitish, a yellow subdorsal line with prominent yellow spots on it on somites 5 to 9, those on 6 and 7 largest. A green lateral line, edged above and below with white, and a white sublateral line. Anal somite produced into a long triangular process, bifid at the tip. Venter, legs and prolegs green. Clothed with short colourless pubescence.

5th (final) instar—Similar. In some examples the yellow subdorsal spots centred with orange.

Pupa suspended by the cremaster. Greyish green, very finely streaked with fuscous. A fuscous dorsal stripe, abdomen with a subdorsal and ventro-lateral fuscous stripe in addition, the subdorsal stripe enclosing white dots on 2nd to 6th abdominal somites. Wing cases with a white line bordered above with fuscous along the upper edge. Shape—head truncate, thorax slightly keeled, wing cases not dilated.

Food-plant—Grasses.

Described from larvae found at Tukdah (5,000 ft. Darjeeling District), one of which pupated 5-vii-44 and a female emerged 12-vii-44.

Moore (*Lep. Ind.*, i, 261, pl. 84, figs. 1, 1a-1d. 1890-92) figures and describes the larva of the subspecies *nilgiriensis* Guer., and also figures it, without a description, in *Lep. Ceyl.*, iii, pl. 210, fig. 4, 1880. Bingham (*Fauna Brit. Ind.*, Butterflies, i, 81. 1905.) quotes this description as follows:—'Larva fusiform, elongated; head conical, the vertex being prolonged to an acute point projecting forward and anal segment also prolonged to a point projecting backwards. Colour green, with darker dorsal and lateral stripes and a slight ochreous subdorsal stripe.'

*Lethe sidonis* Hew., *sidonis*.

Head green, produced above into two pink points with a white line down the back joining the subdorsal body line. Body green, a blue dorsal stripe edged with whitish, a white subdorsal and whitish lateral line, both edged above with dark green, and a white sublateral line. Spiracles white. Venter, legs and prolegs green. Anal somite produced into a long triangular process, bifid at the end.

Pupa with the head truncate and expanded into two slight points fronto-laterally. Thorax with an erect median point. Colour grass green, a cream line along the upper edge of the wing cases and continued round the head. The thoracic point cream. Thorax with a subdorsal series of minute cream specks. Abdomen with two dorsal, a subdorsal and lateral series of two cream specks per somite, a slightly darker green line between the two dorsal series and between the dorsal and subdorsal. Wing cases streaked with fuscous. Suspended by the cremaster.

Food-plant—Grasses.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 31-v-44, pupated 4-vi-44 and a male emerged 16-vi-44.

*Lethe verma* Koll., *sintica* Fruhs.

Ovum—Spherical, the base flattened. Very pale blue, almost white. Surface unsculptured. Laid singly on blades of grass.

1st instar—Head black, hairy, very slightly bifid above. Body white on hatching, becoming green after feeding, with a few short black hairs. Anal somite slightly bifid.

2nd instar—Head green, produced above into two points, with a black lateral line from apex of points. Body green with traces of a whitish subdorsal line and a darker dorsal stripe. Anal somite produced into two points.

3rd instar—Similar, but the anal somite produced into a triangular process, bifid at the tip.

4th instar—Similar to final.

5th (final) instar—Head green, produced above into two long pink processes tipped with black, a double blackish lateral stripe from the base of the processes and a white line down the back. Body apple green, a blue-green dorsal stripe edged with yellow, a zig-zag darker green subdorsal line edged below with yellow, most marked on the 6th and 7th somites, a zig-zag green lateral line and a straight white sublateral. Spiracles dark red. The whole body minutely shagreened with yellow points. Legs, prolegs and venter green. Anal somite produced into two long points held close together, pale blue-green shagreened with white. One example had dark red brown streaks above the yellow on the 6th and 7th somites.

Pupa suspended by the cremaster. Head produced into two large frontal points; thorax slightly keeled; abdomen rounded. Colour yellow green, abdomen with a dorsal, subdorsal, lateral, spiracular and sub-spiracular darker green line, most noticeable intersegmentally, the subdorsal and the spiracular lines edged below with yellow and a zig-zag yellowish line between the dorsal and subdorsal lines. Wing cases with two indistinct fuscous stripes.

Food-plant—Grasses.

Described from larvae bred from ova found at Tukdah (5,000 ft. Darjeeling District), one of which pupated 26-vi-44 and a female emerged 6-vii-44.

*Ypthima sakra* Moore, *sakra*.

Ovum—Greenish white, spherical, the base flattened. Surface very minutely pebbled. Laid singly on blades of grass. Hatched on ninth day.

1st instar—Head pale olive brown. Body almost white when first hatched, becoming greener after feeding, with a subdorsal and lateral purple brown line. Clothed with colourless pubescence.

2nd instar—Head buff, divided above. Body greenish, a dark dorsal, subdorsal and lateral line. Clothed with short blackish hair.

3rd instar—Similar. The points of the head proportionately larger. The lateral line purple brown and with a lateral quadrate dark brown spot on the 7th somite.

4th instar—Similar to final.

5th (final) instar—Head square, divided above into two points. Pale buff, an inverted brown V outlining the clypeus, a dark buff stripe down each cheek, and a dark brown stripe from apex of the point to outside the jaws. Body very pale buff, a brown dorsal, a double buff subdorsal, a dark brown lateral and a brown sub-lateral stripe, all bordered with darker. 3rd somite with a sub-dorsal black speck, 7th somite with a lateral black spot. Legs, prolegs and venter pinkish buff, the latter with a median brown line. Spiracles black. Clothed with brown pubescence. Anal somite produced into a pair of longish processes.

Pupa with the head truncate and produced into a slight triangular projection fronto-laterally, the base of the wing cases expanded slightly, thorax slightly keeled, abdomen slightly angled at the 4th somite which bears a slightly raised ridge. Colour buff, streaked and speckled with dark brown. Head, a dorsal stripe on the thorax and first four abdominal somites a longitudinal stripe along the upper edge of the wing cases and a transverse band across the 4th abdominal somite dark brown. Wing cases with the central half heavily suffused and streaked with dark brown, and with a submarginal series of dark specks. 5th abdominal somite backwards suffused laterally with dark brown. Suspended by the cremaster from a dry blade of grass.

Food-plant—Grasses.

Described from larvae bred from ova laid by a female caught at Tukdah (5,000 ft. Darjeeling District), one of which pupated 13-vi-44 and a male emerged 26-vi-44.

## NYMPHALIDAE.

*Limnitis daraxa* Dbl. & Hew.

Head green, shagreened with white points, and surrounded by a series of twelve black-pointed spines, the spines largest dorsally and decreasing in size laterally. Body green, shagreened with yellow points, and with a sublateral series of small yellow spines. A dark dorsal and a whitish lateral line. 2nd somite with a large, black-spined, whitish, subdorsal scolus, which turns deep pink before pupation. Anal somite bifid. Legs, prolegs and venter whitish green.

Pupa suspended by the cremaster. Eyes expanded into a laterally projecting spine. Thorax keeled, rising to a backward-directed point. Abdomen with a slight dorsal keel, expanded into a large point on the 3rd and a smaller one on the 8th abdominal somite, where the keel terminates. Meso-thorax with a short black subdorsal spine, 3rd to 5th abdominal somites each with a subdorsal spine. A lateral spine at base of wing cases, the upper edge of which is expanded laterally. Colour green. The dorsal keel and points thereon purple brown, a purple brown subdorsal stripe on the abdomen becoming lateral on the 4th somite. The lateral edge of the wing cases, a line outlining the spine from the eye, and the basal portion of the antenna sheath on the dorsum purple brown. The antenna sheath ventrally yellowish white. A spot over the eye, the pro-thorax, a stripe on the posterior edge of the meso-thorax, the dorsal area, except for the keel on the meta-thorax and abdomen, the expanded dorsal edge of the wing cases, and a lateral blotch on the 3rd to 5th abdominal somites brilliantly gilded. Two purple brown specks on the wing cases, two on the leg sheaths, and a central streak at base of proboscis sheath.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 19-vi-44, pupated 22-vi-44 and a female emerged 2-vii-44.

*Pareba vesta* F., *vesta*.

Sevastopulo, *Journ. Bomb. Nat. Hist. Soc.*, xlii, 752. 1941.

Head shining black, hairy, with a pale inverted Y-shaped mark. Body black, the intersegmental areas blotched with dirty whitish, a whitish sublateral line and a cream medio-ventral stripe. Armed with longish, black, branched spines, a subdorsal on the 1st somite, a subdorsal and lateral on the 2nd and 3rd, a subdorsal, lateral and sublateral on the 4th to 11th, and a subdorsal and sublateral on the 12th somite. Legs black. Prolegs black, the feet pinkish. This is a very much darker and dingier form than the one described from Shillong.

Food-plant—Peile (1937, *A Guide to Collecting Butterflies of India*) gives *Debregeasia bicolor* (Urticaceae).

Described from a number of full fed larvae found at Tukdah (5,000 ft. Darjeeling District), one of which pupated 2-v-44 and a male emerged 16-v-44.

#### ERYCINIDAE.

*Zemerus flegyas* Cr., *indicus* Fruhs.

Dudgeon, *Proc. A. S. Beng.*, 140. 1890.

Bingham, *Fauna Brit. Ind.*, Butterflies, i, 499. 1905.

Ovum spherical, the base flattened. Yellow green. Under a lens clothed with fine hairs. Laid singly on the underside of a leaf of the food-plant. Hatched on the eighth day.

Young larva—Pale green, flattened. The termen scalloped laterally. Clothed with white pubescence.

Adult larva—Head small, green. Body yellow green with a cream dorsal stripe edged with darker green. The lateral area speckled with yellow dots. Shape flattened, outline oval, the edges scalloped and fringed with colourless hair.

Pupa flattened, the head rounded with a central cleft, abdominal somites scalloped laterally. Colour pale green. Three longitudinal blue lines on the pro-thorax. Meso-thorax with a dorsal, subdorsal and lateral blue line which diverge and then join again. Abdomen with a dorsal series of blue spots, a subdorsal blue line and a lateral series of oblique blue lines. Wing cases with a blue line on the upper edge. Formed on a pad of white silk and supported by a girdle.

Food-plant—*Maesa chisia* Don.

Described from a larva bred from ova laid in Tukdah (5,000 ft. Darjeeling District), pupated 9-vi-44 and a female emerged 19-vi-44.

Bingham, quoting Dudgeon, gives the following description:— 'Larva adult: length .75 of an inch. Ovate, extremely flattened, inconspicuous. Colour pale green, head and anal segment slightly lighter; all the segments laterally rounded, covered with whitish down, especially at the sides; an indistinct double longitudinal dorsal darker-green line throughout, enclosing a minute orange spot on seventh and eleventh segments; middle segments more than twice as broad as they are long; legs pale green, set well beneath the animal and rather close together. Full grown at the end of March. Feeds on *Maesa montana*. Larva when about to change into the pupal state attaches itself to a patch of silky web, by the last segment, to the underside of a leaf of the food-plant, with the head towards the apex, and is girt about the middle with another web. Pupa length .55 to .70 of an inch. Fusiform, broadest in the middle . . . anterior end truncate-rounded, distinctly broader than the posterior; the whole pupa flattened and of very slight depth even in the thickest part; the divisions between the segments well-marked; posterior segment bluntly rounded; head also rounded and divided in the middle at the apex into two lobes by a shallow notch . . . colour bright yellowish green throughout, marked above with rich emerald-green narrow lines arranged in an arabesque-like pattern on the two outer-thirds; a series of round spots along the middle of the back on the abdomen only, and a subdorsal line on either side interrupted at the segmental constrictions. Under surface pale yellowish green throughout, entirely unmarked . . . The whole surface of the pupa smooth, without any hairs or shagreening whatever.' I did not notice the minute orange spot in any of my larvae, and in my opinion the species is continuous-brooded throughout the summer.

*Dodona ouida* Moore, *oida*.

Ovum—A truncated cone, rounded above, the micropyle a dark, sunken spot. Colour bright mauve. Laid in small, regular batches on the underside of a leaf of the food-plant. The ovum is very much more like that of a moth than that of a butterfly.



Adult larva—Head yellow green with black hairs. Body with the 1st somite yellow green, 2nd to 12th somites with an olive green dorsal stripe edged with yellow green, followed by a wide blue, a narrow blue green, a narrow greenish yellow, an olive green and a greenish yellow stripe. Anal somite yellow green. Venter, legs and prolegs pale green. Spiracles white. Subdorsal and sublateral areas sparsely clothed with erect black bristles. Gregarious. Some colonies of larvae are more tinged with green, others more tinged with blue.

Pupa suspended by a girdle and tail pad of white silk. Rounded, the thorax slightly domed, the head rounded in front and divided by a central cleft into two rounded lobes. Colour yellow green, the lobes of the head yellow. A blue dorsal and subdorsal line, the latter terminating on the 4th abdominal somite and continuing as four blue tubercles. Three blue lines on the wing cases. A lateral series of blue spots on the abdomen and traces of a series of blue spots between the dorsal and subdorsal lines.

The larva is very like that of *Abisara fylla* Dbl., described below, and the pupa similar in shape though not in colour. Both larva and pupa differ widely from those of *Dodona adonira* Hew., also described below, and also from the published description of those of *Dodona eugenes* Bates, the only previously published description of the early stages of a *Dodona* that I know.

Food-plant—*Maesa chisia* Don.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 25-v-44, pupated 1-vi-44 and a male emerged 15-vi-44.

*Dodona adonira* Hew., *adonira*.

Head and body rich green, clothed with short colourless pubescence. Shape tapering to the rear, the anal flap ending in a point. Somites slightly scalloped sublaterally with a fringe of rather longer colourless hair.

Pupa suspended by a girdle and tail pad of white silk. Shape unangled, the head divided into two slight triangular fronto-lateral processes. Colour pale green, the cephalic processes and apex of the abdomen yellow.

Food-plant—*Maesa chisia* Don.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District), 24-v-44, pupated 28-v-44 and a female emerged 10-vi-44.

*Abisara fylla* Dbl.

Head yellow green with a few black bristly hairs. Body green, 1st somite pale blue with a subdorsal blue black spot. A blue dorsal line, a pale blue spiracular stripe with a darker blue line in it and with a whitish stripe below. 12th somite backwards green throughout. A subdorsal series of groups of four black bristles per somite and a sublateral series of groups of colourless hairs with one or two black ones among them arising from slight tuber-

cles. Venter, legs and prolegs whitish. Spiracles yellow green ringed with black.

Pupa suspended by a girdle and tail pad of white silk. Head rounded, with a slight median cleft dividing it into two frontal lobes. Thorax domed. Abdomen stout and slightly humped. Colour deep lemon yellow thickly speckled with rusty red, ventral surface greenish. A dorsal series of six purple spots on the abdominal somites. Spiracles bright blue.

As mentioned above the larva and pupa of this species are very like those of *Dodona ouida* Moore, they differ widely from the published description of the early stages of *Abisara echerius* Stoll.

Food-plant—*Maesa chisia* Don.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 14-vi-44, pupated 22-vi-44 and a male emerged 4-vii-44.

#### LYCAENIDAE.

*Heliophorus brahma* Moore, *brahma*.

Head brown, retractile. Body bright apple green, a darker green dorsal line, a slightly darker green subdorsal and a double lateral line. Clothed with very short colourless pubescence. The usual Lycaenid wood-louse shape.

Pupa yellow green. Abdomen with a purple brown dorsal line and traces of a subdorsal line, a purple brown dorsal blotch on the waist and another on the posterior somites. The thorax and outer margin of the wing cases slightly suffused with purple brown. The purple brown markings vary greatly in extent and intensity. Shape rather stout, the thorax and abdomen domed as usual in Lycaenid pupae, abdomen with a double series of very minute dorsal humps. Slightly pubescent. Formed on a slight mat of white silk on a leaf of the food-plant and held in place by a girdle.

Food-plant—*Rumex* sp.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 11-v-44, pupated 15-v-44 and a male emerged 29-v-44.

#### GRYPOCERA.

##### CELAENORRHINAE.

*Celaenorrhinus plagifera* DeN.

Head very dark purple brown, very large and square, the upper edge slightly indented in the centre. Body dark brownish olive with a black median line. The secondary segmental divisions with lines of very minute yellow dots. Spiracles very pale pink. Venter, legs, prolegs and anal flap pale olive. 1st somite constricted to form a neck. Lives in a silk-lined leaf cell.

Pupa in a silk-lined leaf cell, attached by the cremaster only. Very moth-like in shape, the head with a minute forward-projecting central point. Colour buff, abdomen and thorax minutely speckled with dark brown, intersegmental areas unspeckled.



Food-plant—*Impatiens* sp.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 13-v-44, pupated 25-v-44 and a male emerged 9-vi-44.

#### HETEROPTERINAE.

*Aeromachus stigmata* Moore.

Head yellow green. Body blue green, a darker dorsal line, a white subdorsal stripe and a very fine white sublateral line edged above with olive green. Venter, legs and prolegs pale green. Spiracles white.

Pupa supported by a girdle and tail pad of white silk spun on a blade of grass folded slightly by cross threads. Colour grass green, a darker dorsal line on the abdominal somites, bordered with white, a white subdorsal and a very fine white sublateral line. Shape slender, the head produced frontally into a sharp point, thorax very slightly keeled, body and wing cases unangled.

Food-plant—Grasses.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 5-v-44, pupated 9-v-44 and a male emerged 25-v-44.

*Notocrypta feisthamelii* Bsd., *alysos* Moore.

Head longish, the sides straight, the upper edge slightly cleft. Black with a greenish yellow stripe on each lobe extending from just below the vertex to the sides of the jaws, the clypeus with a greenish yellow bar. Body greyish green minutely speckled with dark green. A white spiracular line. Spiracles white. Venter, legs and prolegs greyish. 1st somite constricted forming a neck. Anal flap broad and flat, and fringed with short white hairs. Lives in a silk-lined leaf cell.

Pupa in a leaf cell, well covered with a waxy powder, and supported by a girdle and tail pad of white silk. Pale watery blue-green with traces of a darker dorsal line on the abdominal somites and a white spiracular line. Shape unangled, the body long, head produced frontally into a point. Proboscis sheath very long and reaching to beyond the end of the abdomen.

Food-plant—*Zinziberaceae* sp.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 12-v-44, pupated 21-v-44 and a male emerged 5-vi-44.

#### PAMPHILINAE.

*Baoris eltola* Hew.

Pupa in a slightly folded leaf, lined with white silk, and supported by a girdle and tail pad. Colour pale watery green, a double white dorsal line on thorax and abdomen, and a subdorsal line on the abdomen only. A fine white spiracular line. Shape long, unangled, head truncate and produced centrally into a long point.

Described from a pupa found at Tukdah (5,000 ft. Darjeeling District) 22-v-44, from which a male emerged 28-v-44.

### HETEROCERA.

#### ZYGAENIDAE.

*Eterusia pulchella* Koll., *pulchella*.

Jordan, *Seitz Indo-Austr. Bombyces*, ix, 32. 1908.

Head brown, retractile. 1st somite olive brown, retractile. Body olive brown tinged with golden with a black dorsal and sub-lateral line. 2nd to 11th somites with a subdorsal series of small tubercles, a lateral series with the tubercles on the 2nd and 3rd somites double, the tubercles of both these series olive brown, and a sublateral series of orange yellow tubercles, those on the 2nd and 3rd somites smaller. 12th somite with a transverse series of four olive brown tubercles. All the tubercles bearing one or two short colourless hairs. Venter, legs and prolegs orange pink.

Cocoon of papery white silk spun in a fold of a leaf. Pupa brownish yellow.

Food-plant—*Melastoma normale* Don., *Rubus* sp. In captivity ate *Lagerstroemia indica* L. Jordan gives Rose, Tea, Polygonum.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 10-vi-44, spun 13-vi-44 and a male emerged 5-vii-44.

Jordan's description in Seitz reads:—'Larva yellowish brown, with black longitudinal lines on the back and sides.'

#### ARCTIIDAE.

*Diacrisia casigneta* Koll.

Head black. Body black, a white lateral dot between the 3rd and 4th somites and a dotted white lateral line from the 5th somite backwards. Clothed with tufts of long black hair, except on the 5th and 6th somites where the hairs are rufous, with a few longer white hairs intermixed on the anterior and posterior somites. Spiracles white. Legs honey colour. Venter and prolegs black, the latter with honey coloured feet.

Cocoon of dark brown silk mixed with larval hair. Pupa bright reddish chestnut. Cremaster two bunches of brown spines.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 28-v-44, spun 3-vi-44 and a male emerged 21-vi-44.

#### LYMANTRIIDAE.

*Dasychira grotei* Moore.

Btlr., *Ill. Het.*, vii, 124, pl. cxxxviii, fig. 7. 1889.

Gardner, *Indian Forest Records*, iii, 197. 1938.

Head bright yellow. Body yellow, slightly tinged with greyish, with a large velvety black patch, almost circular when fully exposed, between the 4th and 5th somites dorsally. 1st somite

with a subdorsal tubercle tufted with long canary yellow hair. A subdorsal, lateral and sublateral series of yellow warts on somites 2 to 11, 2nd to 3rd and 8th to 11th somites with paired dorsal warts in addition. 12th somite with a transverse series of four warts with a fringe of long yellow hair. 4th to 7th somites each with a triangular dorsal brush of yellow hair, 11th somite with a long dorsal pencil of canary yellow hair. Venter yellow with a blackish lateral stripe. Legs pinkish banded with yellow. Prolegs yellow, the feet purple. Dorsal glands greyish. Some examples have the undertint more greenish than greyish. Others have a greyish dorsal and subdorsal line on the thoracic somites and a broad grey dorsal stripe from 6th to 10th somites, and with a few black hairs mixed with the yellow ones.

Immature larvae lack the dorsal brush on the 6th and 7th somites.

Cocoon large, of loosely-woven yellow silk mixed with larval hair. Pupa dark olive brown. Head, thorax and the lateral area of the first four abdominal somites clothed with rufous hair, the rest of the abdomen, except ventrally, clothed with long silky whitish hair. 2nd to 4th abdominal somites each with a large, raised, yellow-brown, dorsal scar. Spiracles with a noticeable pale brown ring.

Food-plant—*Rubus* sp., *Quercus* sp., Apple, *Acacia dealbata*. Butler gives rose and willow, and Gardner *Shorea robusta*, *Lagerstroemia flos-reginae*, *Tectona grandis* and *Psidium guava*. It is presumably a fairly general tree and shrub feeder.

Described from a full grown larva found at Tukdah (5,000 ft. Darjeeling District) 25-v-44, spun 2-vi-44 and a female emerged 16-vi-44.

#### *Euproctis inconcisa* Wlk.

Head very dark olive brown, almost black. Body black, the intersegmental areas frosted with white. 1st somite with a white dorsal line, and a lateral line composed of white dots on the 7th to 10th somites. 3rd to 7th somites thickly clothed on the dorsum with erect, grey, fluffy hair. 4th somite with a velvety black, double, dorsal hump. 8th to 11th somites with subdorsal tufts of dark brown urticating spicules. 1st somite with a subdorsal black tubercle bearing a few dark hairs. A lateral series of brown warts bearing golden brown tufts of short hair. Dorsal glands purple. Venter black streaked transversely with grey. Legs brown. Prolegs black.

Pupa in a cocoon of brown silk mixed with larval hair. Pale yellow brown with traces of a blackish dorsal and subdorsal line. A few colourless hairs. Spiracles black.

Food-plant—*Melastoma normale* Don.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 16-v-44, spun 19-v-44 and a female emerged 4-vi-44.

*Euproctis divisa* Wlk.

Head brown, shining. Body black, the thoracic somites with subdorsal red streaks and with an interrupted pinkish subdorsal line on the 6th to 11th somite. 1st somite with a subdorsal tubercle bearing a long pencil of white-tipped black hair and a brown double dorsal wart with a few short brown hairs. 2nd and 3rd somites with a small subdorsal, a small lateral and a larger sublateral brown wart with a few short brown hairs. 4th somite with a large double dorsal, a lateral and a sublateral brown wart with short brown hairs. 5th to 7th somites each with a subdorsal, lateral and sublateral brown wart with brown hairs. 8th to 11th somites with similar warts but greyish brown in colour. 12th somite with a transverse series of four brown warts. Dorsal glands red. Venter black with a lateral stripe of pinkish streaks. Legs and prolegs pinkish.

Pupa in a cocoon of brown silk mixed with larval hair. Olive brown, the head, thorax and wing cases olive. Spiracles black. Clothed sparsely with short rufous pubescence.

Food-plant—Rose, Apple, *Engelhardtia acerifolia* Bl.

Described from a full grown larva found at Tukdah (5,000 ft. Darjeeling District) 24-v-44, spun 2-vi-44 and a female emerged 16-vi-44.

*Euproctis digramma* Guer.

Head black. Body black, a white dorsal line on the 1st somite becoming subdorsal thereafter, and a white sublateral line. 1st somite with a subdorsal tubercle bearing a few greyish hairs and a dorsal fringe. 2nd and 3rd somites with a double dorsal, a subdorsal, a lateral and a sublateral wart with a few greyish hairs. 4th and 5th somites with a double dorsal hump clothed with dark brown pubescence, and a lateral and sublateral wart with a few grey hairs. 6th and 7th somites similar but the dorsal humps not so prominent and clothed with longer brownish hair. 8th to 11th somites with paired dorsal and lateral patches of urticating black spicules ringed with rust-colour, and with sublateral warts bearing greyish hair. 12th somite with four transverse warts with grey hair. Dorsal glands white. Venter, legs and prolegs black.

Cocoon of brown silk mixed with larval hair. Pupa pale yellow brown, the dorsum rather darker, with the thorax, wing and antenna cases very dark olive. The intersegmental areas blackish. Clothed sparsely with longish, colourless hairs.

Food-plant—*Melastoma normale* Don.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 26-v-44, spun 30-v-44 and a male emerged 18-vi-44.

*Euproctis flavinata* Wlk.

Head orange. Body black, a rust-red dorsal, subdorsal and lateral stripe, the intersegmental areas transversely streaked with rusty red. 1st somite with a subdorsal tubercle with a few black hairs. 2nd and 3rd somites with paired dorsal warts with a few white hairs. 4th to 6th somites with dorsal brushes of short grey

hair. 7th to 10th somites with a double dorsal and a subdorsal brown wart clothed with very short dark brown hair. 11th somite similar but the dorsal warts larger and closer together. 12th somite with a transverse series of four warts bearing short dark brown hair. A lateral series of red warts bearing a few white hairs. Dorsal glands brown. Venter black transversely streaked with yellowish. Legs and prolegs black.

Cocoon of brown silk mixed with larval hair. Pupa orange brown, the venter paler. Wing cases pale olive. Spiracles black. Except for the wing cases clothed with fine colourless hair.

Food-plant—*Melastoma normale* Don.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 27-v-44, spun 28-v-44 and a female emerged 16-vi-44.

#### LASIOCAMPIDAE.

*Paralebeda plagifera* Wlk.

Head pale brown, minutely streaked with darker. Body pale brown minutely streaked and speckled with darker, the thoracic somites with traces of a paler dorsal and subdorsal stripe, the abdominal each with a shield-shaped dorsal mark filled in with red brown streaks and minute blue spots. 2nd and 3rd somites each with a transverse black dorsal fold filled with purple brown bristles. 11th somite darker dorsally, humped, the hump clothed with erect black bristles. Each somite with a large sublateral tubercle bearing a fan-shaped tuft composed of long, pale brown, simple hairs interspersed with a few shorter spatulate hairs, the tubercles on the thoracic somites, of which the first is double, with a dark blue spot on the anterior face. A few short black bristles dorsally. Anal claspers clothed with longish black hair. Venter black, the lateral area pinkish minutely streaked with black. Legs pinkish banded with white. Prolegs purple-brown with a double pale line. The younger larvae are more brightly coloured.

Pupa in a cocoon of yellowish silk, spun among leaves and studded with larval hairs point outwards. Colour dark mahogany, abdomen, head and thorax clothed with short, pale brown pubescence. The intersegmental areas paler in colour and naked. Apex of abdomen blunt.

Food-plant—*Maesa chisia* Don.

Described from a full grown larva found at Tukdah (5,000 ft. Darjeeling District) 4-v-44, spun 9-v-44 and a male emerged 31-v-44.

*Arguda bheroba* Moore.

Head blue-black with a white inverted Y-shaped mark, hairy. 1st somite black with a double dorsal, a subdorsal and a lateral longitudinal orange streak. A thin lateral pencil of long white hair. 2nd and 3rd somites with the dorsum clothed with short rufous, silky hair, a thin erect subdorsal pencil of white hair on each somite, and the skin between dorsally bright orange pink, the lateral area blackish with a white lateral and orange sublateral line. 4th somite backwards with the dorsum slate-grey and the lateral area blackish, a dull black dorsal stripe and subdorsal line

composed of reddish and white streaks, the area between the dorsal stripe and subdorsal line minutely streaked with white. An orange sublateral line, the lateral area with an erect white streak on each of the abdominal somites. The posterior portion of the 7th and anterior of the 8th somite with a blackish dorsal patch edged behind with pink subdorsally. 11th somite with an orange brown dorsal hump clothed with fine black hair and with a thin pencil of long white hair arising subdorsally. 4th to 10th somites each with a few white subdorsal hairs. 12th somite with a transverse orange dorsal band. Venter black, minutely streaked with whitish, and with a white lateral stripe. Legs brown. Prolegs blackish brown with a double pale line externally. Anal flap and claspers coal black.

Cocoon of whitish silk impregnated with a yellowish powder and with the larval hairs protruding. Pupa olive brown, the wing cases, head and thorax almost black. Thorax slightly pubescent. Spiracles raised. A deep subdorsal pit between the thorax and abdomen. The apex of the abdomen blunt.

Food-plant—*Rubus* sp., *Melastoma* sp.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 6-v-44, spun 30-v-44 and a female emerged 20-vi-44.

*Trabala vishnu* Lef.

Sevastopulo, *Journ. Bomb. Nat. Hist. Soc.*, xli, 314. 1939.

Gardner, *Indian Forest Records*, vi, 305. 1941.

Larvae collected at Tukdah (5,000 ft. Darjeeling District) in May 1944 were much darker than Calcutta larvae with a distinct smoky tint.

The cocoons were of dark coffee-brown silk instead of the yellow silk of Calcutta cocoons.

*Cosmotriche pyriformis* Moore.

Hamps., *Fauna Brit. Ind.*, Moths, i, 427. 1892.

Ovum keg shaped, the ends rounded. Very pale blue grey, a darker spot surrounded by a white ring on either side. Micropyle a dark speck. Laid in twos and threes on blades of grass.

Head pale brown striped longitudinally with darker, clothed with longish hair. Ground colour of body dark slate blue, a dark brown dorsal line edged with paler, a pale brown subdorsal stripe speckled with darker brown and a lateral series of oblique pale brown stripes speckled with darker brown. 1st somite with two subdorsal tufts of pale brown hair directed forwards and two pencils of longer hair arising from a lateral and a sublateral tubercle. 2nd somite with a dorsal tuft of black hair posteriorly and 3rd with an orange brown dorsal tuft anteriorly. 11th somite with a dorsal pencil of black hair. 4th to 10th somites with very short subdorsal tufts of black hair. A sublateral fringe of tufts of short, buff, woolly hair, the 5th somite with the tufts longer and white, the base of the prolegs clothed with longer pale brown hair. Spiracles whitish Venter black with a lateral stripe of yellowish freckles. Legs pinkish. Prolegs brown with a paler median stripe.

Pupa in a long spindle-shaped cocoon of brownish yellow silk, spun along a grass stem, and with the larval hairs protruding. Pupa dark mahogany, the intersegmental areas paler, smooth. Anal end rounded.

Food-plant—Grasses.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 1-v-44, spun, 3-v-44 and a male emerged 23-v-44.

Hampson's description reads as follows:—'Dorsum black; lateral area brown; a scarlet lateral line and strigae, grey and black subdorsal tufts on 2nd-11th somites; dorsal red-brown tufts on 1st somite and lateral tufts on each somite.'

#### BOMBYCIDAE.

*Mustilia falcipennis* Wlk.

Head dark brown with short, sparse, colourless pubescence. Body dark brown minutely speckled with yellow dots each of which gives rise to a short colourless bristle. The 1st to 5th somites darker than the rest of the body and with a dark dorsal stripe extending from 6th to 8th somite, this stripe the full width of the dorsum on the anterior edge of the 6th somite but narrowing considerably to the posterior edge, on the 7th somite of equal width throughout and then tapering to a point in the centre of the 8th somite. Thoracic somites with a blackish dorsal line. An extensible sublateral flap of skin on the 3rd, 4th and anterior part of the 5th somite, below which on the forepart of the 3rd somite is a small, black-ringed, orange, inflatable organ. 10th somite slightly humped dorsally. 11th somite with a long, down-turned, fleshy horn. Venter rather paler brown with a median black line as far as the 6th somite. Legs and prolegs dark brown. When the larva is disturbed, the head and first two somites are retracted, the flap of skin on the 3rd and 4th somites is extended, the organ on the 3rd somite is everted looking like a protuberant eye, and the tail is lashed from side to side.

Cocoon of tough brown silk, small, and spun among leaves. Pupa purple-brown, the wing cases and intersegmental area slightly paler. 4th to 7th abdominal somites each with a transverse blackish stripe from just above the spiracle to the ventral area. Cuticle punctate. Thorax with a slight dorsal ridge. Cremaster a spreading bunch of short hooked spines.

Food-plant—*Symplocos* sp.

Described from a full grown larva found at Tukdah (5,000 ft. Darjeeling District) 21-v-44, spun 4-vi-44 and a male emerged 2-vii-44.

*Andraca bipunctata* Wlk.

(N.B.—The larva described under this name in Part 3 of this paper, 1939, *Journ. Bomb. Nat. Hist. Soc.*, xli, 76, belongs to the Bombycid species *Prismosticta fenestrata* Btlr.)

Head dull black, small and slightly hairy. Body with the thoracic somites tapered. Pubescent. Ground colour black, mark-



ed with brownish intersegmentally. A double dorsal, a subdorsal, lateral and sublateral white line, the dorsal lines joined on the 1st and 2nd somites and the joined portion orange brown in colour. A sublateral orange brown blotch on each somite anteriorly. Venter black with a white median and yellowish lateral line. Legs yellowish. Prolegs black with an external white line. The larva is much more like a Notodontid than a Bombycid.

The larvae are gregarious and suffer severely from the attacks of parasites. The resting attitude is contorted, the larva gripping the support with the last three pairs of prolegs only, and holding the anterior and posterior portions of the body erect, the head and first two somites usually curved right back.

Pupa in a thin cocoon of brown silk spun among leaves. Colour dark purple brown, the wing cases slightly paler. Cuticle minutely wrinkled and punctate. Last somite blunt and clothed with short golden brown pubescence.

Food-plant—*Symplocos* sp.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 3-v-44, pupated 8-v-44 and a female emerged 3-vi-44.

(To be continued.)

## SOME REMINISCENCES OF SPORT IN ASSAM.

BY

H. G. H. M.

(Continued from page 118 of this Volume.)

### Part V.

Rewak, in the centre of the Hills, is a delightful spot. The first time I went there two rogue elephants had been proscribed; one was a tusker the other a makna. We tracked them into very heavy, dense jungle where it would have been folly to attack them, especially as the evening was closing in apace. I gave up the idea, and having unloaded my rifle handed it to a Garo who took it up to the village where the people were drinking rice beer. My servants got in with this crowd and I and a Turwa orderly walked on. We were nearing a very large tree when the orderly said, 'I can see the rogue elephant!' and immediately bolted. Going up to the tree I searched with my eyes in every direction but could not make out the animal when, as I was peering round the trunk, a heavy blow struck me on the shoulder. I thought this was from the trunk of the elephant and got a terrific shock! It was the head Garo of the village who had felt uneasy about me and followed after. 'Come', he said, 'come at once, for one of the rogues is above us and the other below.' He took me back to the village by a path and then said, 'It is too late and too dangerous to attempt to return to the bungalow to-night, so you must



sleep at the village.' I lit a pipe and let them drink on, and then told them that I must return as my wife would be very alarmed if I did not do so. After some more potations they were persuaded to accompany me and procured a number of blazing torches. We were passing a clearing a little further on than the aforesaid large tree when there was a shout of, 'Here comes the rogue' and they quickly formed a ring and set fire to the jungle, holding their torches on high. One elephant came right up to the edge of the jungle and was clearly seen. It was the tusker, and I should have fired at it, for had the shot not killed it it would have frightened it away. However, it remained close by. There were now many Garos and they formed a double ring round me. The outer ring went on their knees, holding their spears at an angle, and the inner ring stood with spears held high. They advanced in this formation, burning jungle going ahead, until we reached some boats on the river bank. Into these we all got, torches still burning, and soon gained the centre of the river from where we saw the two elephants following us along the bank. Fortunately they did not cross the river, so we landed on the other side and went up hill to the bungalow as fast as it could be done. The Garos stayed all night near the bungalow and by morning the elephants had gone; there was no trace of them. So ended a very exciting experience.

#### SIX TIGERS IN ONE HOUR.

Mention has been made of six tigers killed in one hour, and it will be conceded that was good hunting. It was when G's camp was not far from the Grass Reserve at the foot of the Bhutan Hills. Some tigers had already been bagged, but on that memorable day it was decided to try for buffalo. The difficulty was to get a shot at the desired animal, which had been seen to have outstanding horns, before it could escape into the sanctuary of the Grass Reserve. After we had failed to get a shot, the Rajah said he would take some beating elephants and try to drive the animal towards us, and placed us so that we could command a clearing in the jungle. 'Now that you four sportsmen command this clearing you may perhaps secure this buffalo having an exceptional head' said G as he moved off towards the edge of the Grass Reserve. We four, the two Ms, the Raj Kumar and I were so placed that we could see any animal coming into the clearing without it seeing us, high up as we were on our elephants and looking over the tall grass. Suddenly a tiger ran across the clearing, taking us all by surprise so that not one of us fired. No buffaloes had been moving and we were not watching the clearing as we should have been. When G came up he scolded us, 'You are a nice lot of shikaris; muddled the buffalo shoot, and now the four of you allowed a tiger to go past without firing at it. Disgraceful.' 'Now', said the Kumar Saheb, 'we must go and get the tiger or father will be very angry indeed.' So off we went with beating elephants, ringed the tiger as they do in Nepal, and drove it towards G. It was a big tigress and

he killed it. We then apologized to him for our disgraceful behaviour as shikaris, and got him to again take an interest in the shoot. He went on ahead and we four were talking, our elephants close to one another, when we saw three tame buffaloes pass into some jungle. This patch of heavy jungle was narrow and the buffaloes had only just gone into it when one of them was killed by a tiger. This was in broad daylight, midday, and some villagers on their house tops called out to tell us of the kill having been made. In such manner do the inhabitants of some parts of Assam live close to savage wild life.

Some beating elephants were at once put in. Where I was stationed the Rajah was just behind me. Suddenly someone called out that the tiger was in the open, behind other guns who were advancing. Two of them swung round and fired, and the tiger dropped dead. Both were using 12 gauge Paradox guns, and that evening had to toss for the claim. It was M who won the trophy. This was a heavy 10 ft. tiger. G always emphasized this point, 'Never be certain what a tiger will do.'

The tiger having been padded we pushed on to where there were said to be four more tigers. The beating elephants went into position, the Raj Kumar with them. I was placed by G where I would be certain to get a shot, and warned by him that I would be charged. Soon the beating elephants signed there were four tigers in the beat. Three came along into the light jungle and were seen by the guns on the right but not fired at. They wanted to see the fun when I would be spotted by the tigers. They had their 'tamasha', for two of the animals charged me. I turned the leading one head over heels with a bullet from my .475 rifle, but the other one pulled up and rejoined the third animal. One of these was killed by G, and the other by M. The Raj Kumar shot the fourth as it was trying to get out of the beat. The Rajah was now very pleased with the bag—six tigers within one short hour, and said we were all very fine shikaris. On arrival at camp we chaired G and carried him round to the accompaniment of 'He's a Jolly Good Fellow'. That red-letter day was the Rajah's birthday anniversary, and no more suitable present could have been given to him than six tigers all shot in a space of one hour.

#### TIGRESS AND CUBS.

One day when roaming about in the jungles I came across two tiger cubs, and as soon as the elephants got close to them they began to growl. They were in some cane jungle near a village. In Assam a tigress frequently has her cubs near a human habitation, and you will find female tigers near to a village even though there are no cubs. It is well known that the male tiger may kill, and even eat, the cubs on occasion, and that perhaps is why the tigress has her cubs near a village and keeps them there. We passed along, and shortly a mahout signalled there was a 'hullee' in front of me; this kept moving in a circle. It was the mother trying to guide the elephants away from where the cubs were. There was a sea of grass and she could have gone right

away; but although she kept on giving the idea that was her intention, she would before long circle round in the direction of the cane brake. The elephants were trampling the jungle down, as they circled around following the tigress's movements, and I knew that she would eventually appear in one of the lanes so made. Suddenly she presented me a view of her broad back just to the right of my elephant, a mark I could not have missed, but unfortunately, though the striker indented the cap, the cartridge did not go off. Opening the rifle I extracted the cartridge, thinking the fault lay with it, put it in my pocket without examining it, and placed another in the breech. After a time I again saw the tigress's back, again presented the 280 rifle and pulled the trigger with the same result as before. I now realized the striker must be at fault, and when I eventually got another chance and fired the left barrel there was a rush away and I was sure she was killed. Darkness was fast approaching so I thought it best to make for camp. In the morning the tigress was recovered and the cubs were caught.

#### SHOOT AT KOCHUGAON.

In April 1924 Mr. H.P.S., who was Forest Officer at Goalpara, invited my wife and me to a tiger shoot at Kochugaon. Several things happened at that shoot which are interesting.

I was asked to bring along solid bullet ammunition as the Assam Government had ordered a male elephant named Urthumpersad to be destroyed. He was a fine tusker but an unreliable animal, and had killed many attendants, mahouts as well as grass-cutters. I knew him well, and as a shikar elephant he was dangerous so could not be used for howdah work. I remembered that he had screeched and bolted when men were trying to put a shot jungle fowl on his back. He was a timid and a terrible coward. On our way we picked up the Rajah of G who had been also asked to the shoot and to assist by taking charge of the arrangements and giving use of his elephants to supplement the animals of the Forest Department.

While we were at tea at Kochugaon G, who did not drink tea, sat quietly listening and then declared, 'It would be a shame to shoot the animal, for perhaps with care he could be trained to become useful, as a beater if nothing else. The mahout is probably to blame.' C, who had just arrived from England and taken charge of the District as Forest Officer from S remarked to G, 'You could never train that animal, nearly all the forest officers in the Province have at some time had the elephant in their charge and it has invariably been the opinion that he should be destroyed.' G said, 'I would like to try and reform him, for mahouts are often to blame—they are themselves frightened and make the elephant useless. If you will sell him to me I will give you the price of his tusks.' C agreed, and Urthumpersad was taken to G's elephant lines. Two years afterwards I saw the elephant at a shoot and used for howdah work. He was perfectly steady even when he knew there was a tiger in front of him, and tigers were shot from his back. What G could not

drive out of him was his uncertain temper, for I know he killed grass-cutters while with him, and he eventually had to shoot him as hopeless in that respect, the culminating incident being that he was loaned to the Forest Department, along with other animals, and while there, as seen by B, another forest officer, seized an attendant with his trunk, carried the unfortunate man across a stream and killed him.

One day we went to a far away grass jungle and beat a large piece of it with all the elephants in line. In places the grass was so high that even howdah elephants on either side could not be seen. I was on the extreme right on Mylo, an elephant which later on proved to be one of G's best howdah animals. On this occasion he killed a small hog deer with his trunk as the animal ran across him. Mylo is a small 'mukna' and I have many times seen him stand the charge of a tiger. Suddenly the Rajah beckoned to me to come to him, and in a fairly large clearing I saw a small beating elephant being chased round and round by a female rhinoceros with its half grown young one following after. It was a fine and unusual sight. After chasing around some of the other elephants she went off with her young one. This affair had caused a great dispersal of the beating elephants and most of the Forest Department animals were missing, including the mounts of C and S which completely disappeared. G said that it was because the Forest mahouts feared the rhino and so got their animals out of the arena as quickly as possible.

On a Saturday morning a kill was reported a long way off so an early start was made. On arrival at the ground G inspected the kill and turning to me said, 'Now, Sir, where is the tiger?' Thanks to his tuition I was at that time fairly learned in the habit of tigers, so I pointed to the 'nakul' jungle. Nakul is a broad leafed plant growing very thickly and in it a tiger finds plenty of shade during the hot hours of the day. 'Yes, and you are to drive him out and not shoot unless he attacks you.' He then proceeded to arrange the beat and place the guns. C was placed on the ground below and when the beat commenced I pushed on to a thick part of the nakul jungle. When I arrived the tiger showed his very plain displeasure and growled continually, but never showed himself. Mylo, perhaps wisely, refused to walk on top of the tiger although urged by the mahout. I was in a difficult position for had the tiger attacked I could not have stopped him. Had he made a move to do so I would have fired off both barrels to try and save the elephant from a mauling, for if hit or not the noise can have the effect of halting a charge. Some beating elephants came up, and shouting together the mahouts forced the tiger on, and he broke cover towards C. Soon I heard a shot and then saw C's elephant bolting out of the fray. G came up and asked why C had not shot the tiger, and where is he? 'There' said the mahouts, 'there he goes. *Wo jata hai....Wo gaia!*' and his elephant was not stopped for a long distance. C later explained that he was helpless as his elephant danced a polka as soon as she discovered the tiger coming.

Next day, Sunday, early report arrived that the tiger was back in the same place. It being Sunday I said I would not go out and of course was ragged, and told I had a slave mentality and so on. However, the others went off after breakfast. G located the tiger and arranged the beat, again putting C in the best position. He told C that the tiger would come along on the top of the nala bank and not along the nala bed, but C, being of opinion that a tiger always comes along that way considered that he knew better than G so took up position in the bed of the nala. The tiger, of course, came along the top as predicted by G and C was too late to get his elephant up the rise to meet him; worse, he disturbed a nest of hornets which attacked the elephant and its riders. The elephant, maddened with stings, ran all over the country and did not get to camp until after dark. C had two stings high up on the neck near the spine and could scarcely stand. I assisted him to a chair, gave him a stiff peg of whisky, and went off to the dispensary to obtain medicines and a hypodermic syringe. Mrs. C, not knowing I had given him a still peg gave him another and put him to bed. He was soon asleep! During the maddened elephant's rampagings in the jungle C lost his spectacles, camera, thermos flask, none of which were ever recovered. After this experience he said he would not again joke about Sunday shooting, and would not shoot on Sundays. This is another instance of how tiger shooting off elephants can be dangerous.

Bees and hornets may be disturbed during a beat, or at any time, even when going to or returning from the jungle, so one must not forget always to have a blanket with one when on an elephant. The placing of the blanket over the elephant's eyes may also have the effect of stopping the running away of a 'muth' elephant.

On Monday morning news was received of a number of tigers giving trouble a long way off. When we got to the place, we, S and I, C had not come out as he felt helpless without his glasses, thought the place looked very unlikely and we were disappointed. G was cheerful and said he had bagged tigers in more unlikely places. There was a small stream and the grass jungle about it was not extensive, neither was it dense, moreover there were fields all round and people working in them all day.

G placed himself on the bank of the stream with S on the other side and I on his right. The beat had barely advanced 300 yards when it was signalled there were three tigers, and G passed word to us to be prepared for a charge as we were barring the way to the thick jungles the animals had come from. Soon the Rajah told us to move towards the beating elephants. A tiger charged G, and staunch as was Rung-Bahadur he jinked, so causing G to miss it in the air as he came; the explosion baulked the tiger so he failed to get on the elephant. Again G was charged by the same or another animal, but this time he killed it in the air and I saw it fall in a heap. We had scarcely advanced a hundred yards when I was charged by a tiger which came at me over an open field. I had a fine view of it, and when I fired it

sat up like a great cat and sort of stretched itself. I fired again and it jumped sideways into some cover. When we looked we found it dead. G now stopped the beat until S could get across the stream to our side and have his chance. Presently we saw S put his rifle to his shoulder and two tigers sprang across the opening he was guarding. He wounded one which went across the stream. It lay down in full view and he fired shot after shot at it with his 500 black powder rifle. We could see the bullets hit and cause wounds, but these were only surface wounds. We crossed the stream and finished it.

We thought the fourth tiger had gone right away and S and I had got down from our howdahs, G also, when a mahout reported he had seen the tiger not far away. G hastily mounted, and before the tiger could reach the dense cover he shot it. It was barely an hour since we commenced to beat this unpromising place and we had killed four tigers! Two were males and two females. Back at camp C cursed his luck and was fully convinced of the wrongness of Sunday shikar.

The cartridges of the .500 black powder rifle S was using were loaded with the light .340 grain bullet having a long hollow and small base; the .440 grain heavy based bullet is the proper one to use with that rifle.

Next morning a tiger was reported within half a mile of the camp and G sent word asking us to turn out. C could not go without glasses and S was too tired. I went with G and got on to Mylo, and we took our positions. I knew G had directed the tiger should be driven to me but made up my mind to let it pass on to him. It came from in front of the beating line into some scrub jungle and was passing along towards G when a beating elephant came out and turned it back; I could not see where it was when it suddenly stood up on its hind legs before Mylo. As it went down again I threw up my rifle (.280) without taking aim and by a mere fluke hit it in the side of the head. The skull was broken into several pieces and the animal was instantly killed. The distance was close, about 15 yards. The mahouts saw the tiger go over and cheered; and an Indian Forest Ranger remarked, 'That is the man to go out with for he can kill a fighting tiger with one shot.' I told the Rajah that the tiger was not fighting and was killed by mere chance. He put his finger to his lips, 'Hush', he said, 'you must never own to a fluke to the mahouts. You have greatly enhanced your reputation with them so any of them will be prepared to keep his elephant still, depending entirely on your shooting. A person who has missed several times, though he be a first class shot, will not be trusted by the mahouts and he can talk and tell them what he likes, they will pretend to agree, but will hold to their own opinion saying among themselves that the man who has fired three shots and not hit once can't be any good; and whenever possible they will make the elephant bolt before the tiger gets near, or will make some excuse to get the elephant out of the way and into some position where no tiger is likely to come. They well know the habits of a tiger and will be able to arrange that you do not get a shot.

## HOW A TIGER CHARGES.

Viewed from an elephant a tiger's charge is nothing like what it is popularly thought to be, a roaring and coming at you with leaps and bounds. It is absolutely silent except for the first warning grunt as it breaks cover, and it comes along very fast with its belly almost touching the ground, no bounds. When within springing distance, about 15 to 20 feet from the elephant, it springs to land on his trunk. I have seen the charge time, and time again, it is always the same. What the charge against the man on foot is like I do not know for I have not seen such a performance, but I think it must be similar.

A tiger's back as viewed from an elephant is fairly broad, and if the bead is placed in front of the on-coming beast, and moved towards it, and the trigger pulled as soon as the bead touches the centre of what is really the head, the bullet will probably get the chest through the back. A charging tiger, seen from an elephant's back, may be described as having the shape of a gigantic tadpole.

## WILDFOWL AND WILD PEOPLE IN MANIPUR.

Manipur is famous for its duck shooting. The jheel is seven miles long and affords fine sport. The shooting is conducted quite differently to shoots on jheels in other parts of India. In Manipur platforms of wood and bamboo are erected in various parts of the expanse of water, and in the grass. They are quite hidden as they are maintained all the year round, and the grass grows all round them thus entirely hiding them, and as the birds have been all about and around these machans in the water without being scared, when a shoot is in actual progress easy shots are obtained, at any rate, at first. When the sportsmen have taken up their positions a number of boats, with a gun in each, go around the jheel putting up the birds and then the fun begins. Round each platform is usually some clear water so that birds shot can be easily retrieved. After a time boats come round and pick up the dead birds. While this is being done the birds settle down again, and after they have rested a while the whole proceeding is re-enacted.

Enormous bags have been made in this way. I think Colonel G. of an Assam Battalion stationed at Imphal held the record of 300 to his own gun; and he once shot 90 geese in one day. On the last time I did a shoot at Manipur I was stationed at Kohima and we used often to go into Imphal to play cricket, about which the then Maharajah was very keen. On those occasions we would also put in a day or two of duck shooting. Very large bags of snipe have also been made there, Colonel G. again holding the record in those parts for a single gun.

When great celebrities, Viceroy, Governor, and other High Officials visited Kohima there would be extensive security arrangements. The Naga hillmen used to undertake to guard the road from Dimapur to Kohima, and again from Kohima to the boundary of the Naga Hills. They lined both sides of the road and were dressed in full war regalia. They of course searched in the jungle on both sides of the road and any evilly disposed man would



have received the shortest of shifts, for his head would have been instantly lopped off in skilled headhunter fashion! From the Naga Boundary to Imphal in Manipur the roads were lined on both sides by armed men of the Assam Rifles.

Naga dances arranged in honour of these official visitors were very special entertainments for eight tribes dressed in their colourful tribal costumes danced their very best. It is a very gorgeous, spectacular affair and there is a certain amount of danger, for most of those taking part are more or less drunk on their homemade rice spirit, and it would not take much provocation for one tribe to use spears or other weapons on another. At the present day (1944) the Nagas will not be as they were in earlier days for the improvement of road and the military traffic and other activities have brought many aspects of civilization to the originally simple tribes.

One evening we heard a barking deer call, on the hill above the bungalow. I asked my wife if she would like to try for it and as she said she would I told her to go up the fields by the regular path and I would go by another way which would probably cause the deer to move in her direction. As I got to the fields, which were not in use at the time, and in them were a lot of logs lying about some trees having been cut, I saw an animal which I took in the failing light to be a reddish calf, for a little higher up the hill there were cattle kept by a Garo. I thought the calf was a straggler going up to the byre, and it never entered my mind that the animal might be a tiger.

As my wife came on to these deserted fields she saw the tiger: it was only twenty-five yards from her and looking in her direction. Rakal Singh was with her and kept his head and did not do anything silly. The tiger was perhaps a little closer to me than twenty-five yards. My wife called out to me that to my left is a tiger. I knelt behind a log and covered his chest but had sufficient experience to know that if I fired and the animal was not killed outright he would spring in the direction he was looking, and that was in direction of my wife, so it would have been madness for me to fire. The tiger turned and was soon out of sight. My wife showed no panic or fright at all and looked at the tiger with no attempt to get away in the other direction. Few women have been so close to a wild tiger in its natural jungles.

#### PYTHON AT MOHENDRAGUNJ.

While I was staying at the Inspection Bungalow, Garos came and told me that a herd of mithun were destroying their fields and one of them had very fine horns. For various reasons the search for the animal with the big horns failed. On the largest of several small hills there was a pathway leading right round it. A Garo tracker and I were following the spoor of the mithun and the shikari went on ahead to spy round the corner. I remained behind and, not knowing it, was actually standing six or seven paces from a python lying in the grass with its head protruding from a bush. I beckoned to the shikari to come back and he was talking to me when, why I did I cannot say, but I looked to his left and



above on the hill I saw the thick body of a large python lying in an upward direction along the hill. Now, following the snake's body downwards I found it ended in a bush by which the shikari was standing. Walking towards him I saw the creature's head—it was almost touching his toes (a matter of inches). I drew the man gently away and as soon as he was clear of the bush drew his attention to the snake by means of signs. He pointed to my rifle but I shook my head. He then took a large knife I was wearing and cut a thick branch, as thick as my wrist, and having trimmed it went towards the snake and, taking aim at its head very deliberately killed it. As soon as the head was hit and completely crushed the body moved about until it rolled down the hill. It was 13 feet long and was not gorged for it had nothing in its body. Was the shikari in any danger when his toes were within inches of the python's nose? Pythons watch game paths to seize deer and other animals passing along and it is strange that it did not attack the man.

#### ANOTHER PANTHER STORY.

My wife and I arrived at Kirapara about midday and the watchman reported that a panther had killed a cow that morning and dragged it into a near-by ravine. After having had something to eat I went with Rakal Singh, shikari, to view the 'kill', and we decided to sit up straight away. By his tracks we learnt that the panther had gone up the hill opposite to where we were concealing ourselves. He could not but return the same way he had gone. I had with me a .280 straight-pull magazine rifle, and a 12 gauge gun loaded with buckshot cartridges, the best weapon to use at close quarters against panther.

It was exactly 4 o'clock when Rakal Singh kept on kicking at me from behind. He was trying to tell me that the panther had arrived. I knew what he meant but could not see the animal, though I searched every inch of ground around the kill. I tried to slowly turn round but the beast instantly detected the movement and bolted, making such a noise that it was at once apparent where he had been—a good distance above the carcase, on the hill-side. The shikari said in a very disgusted way, 'Had you only looked above the kill you would have seen the panther sitting up like a dog and looking at us. You could have easily shot him, He had been there five minutes and I hadn't seen him.' 'Now,' said Rakal Singh, 'he is hungry, and we will get him. I will fetch some Garos to drag the kill to just below the bungalow where you can sit up for him.' I said he would not follow the drag. 'Oh yes,' said the shikari, 'he will follow by scent.' When the carcase had been dragged to where wanted I had dinner, and Rakal Singh tied a lantern to a bush close by, so lighting the carcase very well. I doubted whether the panther would put in an appearance but all the Garos said, 'He is very hungry and has never been shot at, he is certain to come back.' I got into a small tree at the edge of the bungalow compound but could not see my rifle sights. My wife suggested that if he was thought not to mind a light near the

kill, he would not object to one up the tree. So a man climbed up, tied a rope to a higher branch and lowered the lantern until I could see my sights.

In about half an hour I saw a grey object rising from the back of the kill, and it appeared to get taller; it was only a grey thing I could see and I could not say it was the panther. However, I fired a shot at it and it disappeared. After a time the same grey object started to again appear and I fired another round at it. Then there was a rush towards the tree on which I was perched, then a sudden turn to the right, and a rush into the jungle followed by several groans. The men said the beast was dead, but I refused to let them search in the dark. Though I had warned them not to go in the morning until I was with them, the waterman did go. He climbed several trees until he descried the dead panther. It was a forest-dwelling, game-hunting panther in good condition, and not the kind which frequents the vicinity of the villages, so had no experience of men and their ways.

One .280 bullet had hit it in the back and run along close to the spine without injuring it; the other had also hit the back, but at a different angle, and entered into the chest severely damaging a lung. This was the shot that killed it. The first bullet had come out near the tail and then burst in the ground. The interesting part of this affair is that the panther was not put off his prospective dinner by the first explosion of the rifle and the bullet passing under his skin for the length of his body, a wound which must have felt to him like the lightning thrust of a red-hot skewer!

#### THE LAST SHOOT.

The latest shoot I was on my wife and daughter were of the party. It was a long journey from Bangalore to Calcutta. I had not attended those big shoots for five or six years and there were some gaps among the well remembered attendants. The old cook was dead, so also the schoolmaster and the head shikari. Among the elephants Rang Bahadur, Sibjee, and others were absent but Jang Bahadur and Mylo still working. Our old friend, the Rajah of G. was as pleased to see us as we were to see him, and we had much to talk about.

It was reported that a large tiger had killed in a certain jungle so we all set out, my daughter in my howdah. The tiger was to be shot by an Indian guest so M Senior was stationed next to him to see that matters went as intended. The tiger was found, and the beating elephants swung round to push him towards the lighter jungle when it was suddenly seen that a party of women and children had entered the grass and got ahead of the tiger. They, of course, did not know that a beat was in progress, and as it had taken a little time to diagnose this new 'hullee' it was realized they were in great danger. The beat was spoilt as the mahouts had to shout to the people to clear out of the jungle, and the result of all this was that the tiger went left instead of right. It could be seen by his 'hullee' that he was in front of me and I prepared to fire but he did not show; for after about a minute—evidently turning over in his mind what he would do, he moved towards M.

Junior who gave him a mortal wound with a heavy conical bullet from his 12 bore Paradox. The wounded beast then passed through a clear space, going slowly, and Dorothy got her first view of a wild tiger, and a big one too. I fired and he rolled over into the grass. A fine beast measuring ten feet over the curves.

I have always considered skin measurements over the curves to be the better method, as it is then possible to compare lengths of animals with those shot in the years before the peg-to-peg measurements began to be considered correct. The difference between curve and peg measurement, if each are properly taken, is some six to eight inches. The twelve feet tigers of former days were the result of wet skin measurements, skins after removal from the animals being pulled out as far as they would go thus giving the appearance of a striped python on the ground. A friend has recently told me that he himself read the original report of a sportsman who wrote, not twenty years ago, to the Civil Officer of the District that he had just shot three tigers 13 ft. 9 in., 12 ft. 7 in. and 11 ft. 10 in. in length! That was the method employed; so the foolish practice seems to still exist.

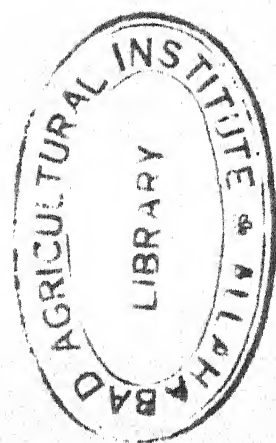
One day four tigers were obtained, one of them being shot by me with the .280. My daughter now begged to be allowed to shoot a tiger, and the Rajah said he knew this request was coming as he had received a letter from her husband saying 'she is a very good shot at a target'. 'So', said G. 'your girl may have her chance provided you take charge of her and see she makes no mistake'. To this I of course agreed and the beat next day was arranged for her benefit, but so that she could only fire in one direction, the elephants of the brothers M. being on either side of ours. G. lent D., which will stand for either Dorothy or 'Diana', his D.B. .450 black powder rifle. The tiger was pressed forward, but seeing our elephant waiting for him growled and went back into heavy cover where he demonstrated against some of the elephants causing them to scare. G. then went to the beating line and brought it along very silently.

Being over anxious that nothing untoward should happen I loaded D's rifle in the left barrel only, telling her to pull the left trigger. The tiger jumped out with a grunt, and in her excitement D. pulled the right and not the left trigger. She had a good view of the tiger, and it can be said that the loss of her opportunity was my fault as the right barrel should have been loaded. G. realized that I, her father, had too great a responsibility so, with his usual kindness and generosity, took her next day in his own howdah. Two three-quarter cubs appeared in the first beat. In a second beat one of these two beasts was brought to D's gun and killed by her, her first tiger and one of three killed that day.

\* \* \* \* \*

The author of this series read the almost completed compilation, culled from his several Note Books, before he became ill early this year (1944).

Major H. G. H. Munrowd was not, unfortunately, a member of the Bombay Natural History Society. His death took place at Bangalore on the 21st March 1944. All members will be at one





*Sus barbatus* BEARDED FIG.

Drawn from photographs by Mr. Romenij in 'Journal Royal Asiatic Society', Straits Branch; No. 45: 1935.

JFK

with the Committee in expressing regret to his family that he should have passed away before seeing his experiences in print and contributing, as he had hoped to do, some more of his interesting Assam Reminiscences.—Eds.

(The end.)

## THE RIDDLE OF THE BEARDED PIG.

A PROBLEM OF DISTRIBUTION.

BY

J. E. KEMPE

(School of Oriental and African Studies, London University)

(With 4 plates)

Three distinct species of wild swine have for long been recognized in the western portion of the Malaysian sub-region, that is the area (excluding Celebes and the Philippines), lying south and east of Burma, together with a number of somewhat disputable local forms. These are *Sus cristatus* (local representative of *Sus scrofa* of Europe and western Asia including India and Burma), *S. barbatus* of Sumatra, Borneo and the Riau Archipelago and *S. verrucosus* of Java. The last is not of interest in this discussion and may be dismissed. *S. cristatus* and *S. barbatus* overlap and occur together e.g. in Sumatra. But that the only wild pig of the Malay Peninsula was *S. cristatus* was never in question until 1918, when Dr. W. S. Leicester of the Malayan medical service, stationed at Pekan in the State of Pahang on the east coast of the peninsula some 160 miles directly north of Singapore, shot the sow of a species new to him. Dr. Leicester kept a pack of mongrel dogs and for some years hunted that remote country as a regular pastime. He apparently shot several half grown young pigs as well about the same time, and in December of that year sent the sow's skull to the Director of Museums at Kuala Lumpur (the late Mr. H. C. Robinson). The latter, in his own words, found 'the occurrence so remarkable and so at variance with preconceived ideas of geographical distribution, that, pending further evidence, it was not considered advisable to place the occurrence on record'.

There the matter rested till September 1921 when the writer, stationed at Pekan as District Officer and quite unaware of the foregoing, was shown the skull of a pig shot by an old Chinese named Lee Chu'ah with whom he frequently hunted. Chu'ah shot the animal at Sungei Genoh a week before, a mile or two out of the town. It was an old solitary boar and much emaciated. What impressed the man was its great height and length of leg, the length of its skull, a pallid skin, the tufts of hair under its eyes and above all its whiskery beard. It weighed 244 pounds and he thought that in condition, it should have scaled well over 300—and a Chinese is no mean judge of pig-flesh. Chu'ah had hunted that coast for nearly forty years and never before saw such

a monstrous pig in all the thousands killed by him. (The old man, a great comrade in a lonely place, died two months later.) I at once sent the skull which he gave me to Major Moulton, the Director of Raffles Museum, Singapore. To me it was an astonishing object, and comparative drawings of it and the common *S. cristatus* made the difference more remarkable. It was not I think a very big specimen judging from the measurements of the skull. Chu'ah who combined business with pleasure and a genuine interest in his quarry, had for years kept careful records of his kills. The heaviest recorded pig of the common type was he told me 286 pounds (he showed me a grubby notebook full of Chinese characters and ill-formed English figures, for he was by way of being a scholar), but his pack was probably unequal to stopping any thing much heavier. The tushes of the strange pig were nine inches round the curve and  $4\frac{1}{5}$  inch across. The Director of Museums identified the skull at once as that of *Sus barbatus* of Sumatra and Borneo and Riau, and retained it as 'the first authentic record of this species in the Malay peninsula'. In March 1922 there appeared an article in the Journal of the Royal Asiatic Society (Straits Branch) No. 85, under the hands of Major Moulton and Mr. H. C. Robinson. The species was accepted as a member of the Peninsula fauna though they thought its presence 'is really due to some extraordinary chance resulting in the landing of a herd from Borneo, the home of the true *S. barbatus*, or from the Riau archipelago'. If, as the writers pointed out, it is a Peninsula species, the geographical position is difficult to explain, but under *very* favourable circumstances individuals might come over from the islands and establish themselves in small numbers for a noticeable period. The verdict was '*not indigenous*', that it was probably the last survivor of a herd that had gained access to Malay peninsula. The matter rested for a time but the question seemed to me, in face of the facts, to be by no means settled.

Seventeen years later, in March 1939, I wrote to the then Director of Museums in Singapore (the late Mr. F. N. Chasen) and enquired whether the Bearded Pig had turned up again since, and if so, what was the present view of the matter. In April of that year he replied that the pig had turned up on several occasions in small numbers on the east coast of the peninsula but not on the west. The latest example was a fine boar from Kota Tinggi, near the southern tip of the peninsula. This specimen was retrieved by Sir Richard Winsted from an Italian who expressed the intention of sending it to Signor Mussolini. He was easily persuaded to hand it over by the suggestion that the head of a *seladang* or any other head would please the Duce just as much, and it was placed in the Raffles Museum. The Director went on to a 'possible' (but most surprising) solution of the presence of the pig in Malaya—it was evident that the Museum authorities were uneasy about it! He stated that the Chief Minister of Johor was certain that 'our *barbatus* pigs are the remains of some introduced by the old Sultan many years ago—for sporting purposes—and may be he is right'. (This aspect is referred to at greater length later).





Map of the western part of the Malaysian Sub-Region showing the known distribution of *Sus* on the larger land areas.

The Javanese species is *S. verrucosus*. The species themselves are divided into several local sub-species.





⊙ Sites of recorded occurrences of *Sus barbatus* in the Peninsula.

NOTE.—A mountain backbone runs down the middle of the Peninsula, altitude up to 7,000 ft.

But this is not the end of the story. In 1939-40 a series of excavations were carried out in deposits in the limestone caves of Kelantan in the north of the Peninsula by the ethnological branch of the Museums Department. At Goa Madu the list of mammalian remains of Neolithic (recent) date includes the bones of both *Sus cristatus* and *S. barbatus*. As the Director wrote in August 1940 (vide *Journ., Royal Asiatic Society*, vol. xviii, Pt. 2 page 7)—the remains prove that the Bearded Pig is truly indigenous in the Malay peninsula. He adds that 'the species was only recently discovered in the Malay States . . . it had been suggested that the few known specimens are the remains of a herd imported by a former Sultan of Johor'.

A year or two later Singapore fell. So the riddle remains for the time unanswered.

## PART II

So the known facts are that the Bearded Pig did inhabit the Peninsula, (certainly the northern part of it near the present Thailand frontier), in a Neolithic age which corresponded here probably to the early Christian era, and that it has in recent years reappeared in the south and east in small numbers. In the interval there is no record of it, though Malay lore has a semi-legendary monster, a lone boar of heroic dimensions existing in the forests, a travellers' tale. In Johor there are stories of a 'great white' pig seen by few. But nothing substantial is to be discovered. There is no record at all of any occurrence of this animal on the western seaboard.

The questions that arise are, is it, by its presence today, to be regarded as indigenous in the sense of being either a still established survivor of Sundaland, or as possibly re-establishing itself after a period of extinction?

*The question of Survival.*—What has happened to *barbatus* during the long period since it was hunted in Neolithic times, not so long ago? The wild pig is not an animal that readily conceals its presence. Most common and usually to be found on the fringes of cultivation, it is both a pest to be slaughtered at any time and the ordinary quarry of the hunter with his dog pack which exists in most villages for sporting and protective purposes. Old Chu'ah was one of scores of semi-professional hunters. Many hundreds or perhaps thousands are killed annually. It seems almost inconceivable that a race of wild swine such as the Bearded Pig with its signal characteristics could have escaped notice. When it has turned up it has provoked astonishment. Its habits do not seem to differ from those of the common *Sus cristatus* nor its natural terrain. *Barbatus* lives side by side in Sumatra with *cristatus*—and in the islands of the Raiu Archipelago—and it is not clear why it should have given way on the Peninsula. It has to be remembered that until quite lately, about fifty years ago, the ecological state of the Peninsula was still primeval, the population very small indeed and confined to the rivers and coasts. Nothing happened then or has since with the opening of the country that could affect its status.

There is, it is true, a large area in Pahang where the interior, covering a country about as big as Yorkshire, is mainly unexplored

owing to its swampy and valueless nature, that may contain more specimens of this great pig but there is no known record of it whatever. Chu'ah who lived on the edge of it all his life never heard of it.

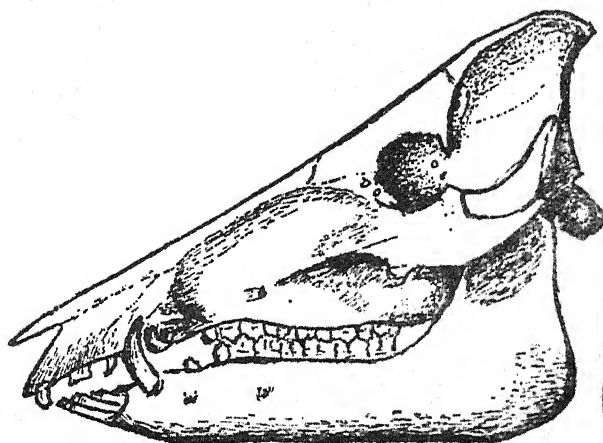
*The question of Re-establishment.* If it is not a survival, then the pigs presence in the past quarter of a century is due either to deliberate introduction or to that series of 'favourable circumstances leading to its establishment in small numbers' postulated by Moulton.

Introduction attributable to human agency may be considered first. It is well known that the distribution of the 'rusa' (the Malayan sambar—*Cervus equinus*) has been affected over the archipelago by its planned introduction onto a number of islands, at one time slightly to the embarrassment of the zoographers of that tangled sub-region. But that there should be a similar dissemination by human agency of a detested and generally untouchable pest in numbers sufficient to found a colony is a very indigestible supposition. As regards the Johor story, historically, there have been two Sultans only in the past seventy years and the present ruler's predecessor was the Sultan Abubakar well known to law students in a leading case. He spent much time at the court of St. James and was a pious and erudite Mohammedan. It is difficult to believe that he or any other Sultan—Mohammedans all—would have taken the trouble to catch up and import a consignment of pigs which are regarded by Malays as nothing but foul and destructive vermin, for their specific difference. It is a pest too near home! Such an importation, it is considered, would have to be on a fairly big scale to form the nucleus of a population that in a short time spread 170 miles to the north. A few menagerie specimens for example, would seem inadequate. The Bearded Pig has, according to Shelford, some reputation as a migrant and in Borneo large numbers periodically move across country to fresh ground, due perhaps to pressure of local populations. The journey to Pekan where it was first shot by Dr. Leicester and Chu'ah, would involve a great deal more than 170 miles of direct travel and entail the crossing of more than one stretch of mountain country and several considerable rivers.

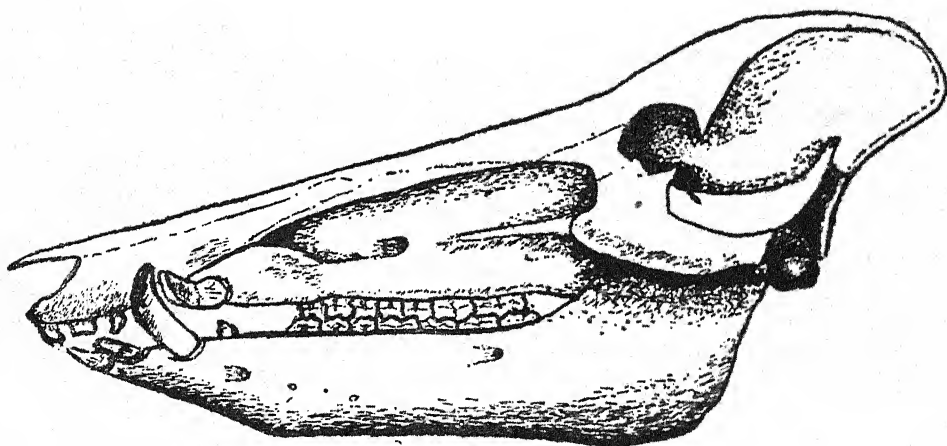
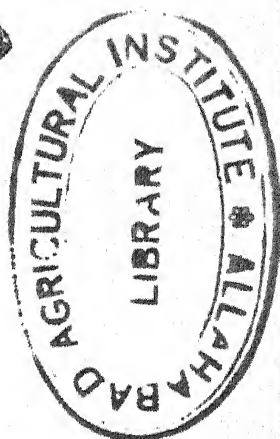
Still the story should be further investigated, though incredulity is felt as to its value.

What then is the likelihood of reintroduction by natural means—by the occurrence of those favourable conditions envisaged by Moulton?

The nearest islands to the southern tip of Johor (Cape Roumania) are those of the Riau Archipelago with Pulau Batam lying some ten miles to the southward. Between lies the ocean passage from Singapore for China bound traffic—a stretch of tide rips and fast currents. Yet *given the right conditions* wild animals do cross wide intervals. Many, including the wild pig are excellent swimmers. After the great floods of 1927 when the rivers in Pahang rose over sixty feet and inundated huge tracts of country, many wild animals were washed out to sea, pigs among them, and a tiger too, (one was found swimming five miles offshore). One pig of the *cristatus* species arrived on the island of Pulau Tinggi ten



*Sus cristatus*  $\times \frac{1}{4}$



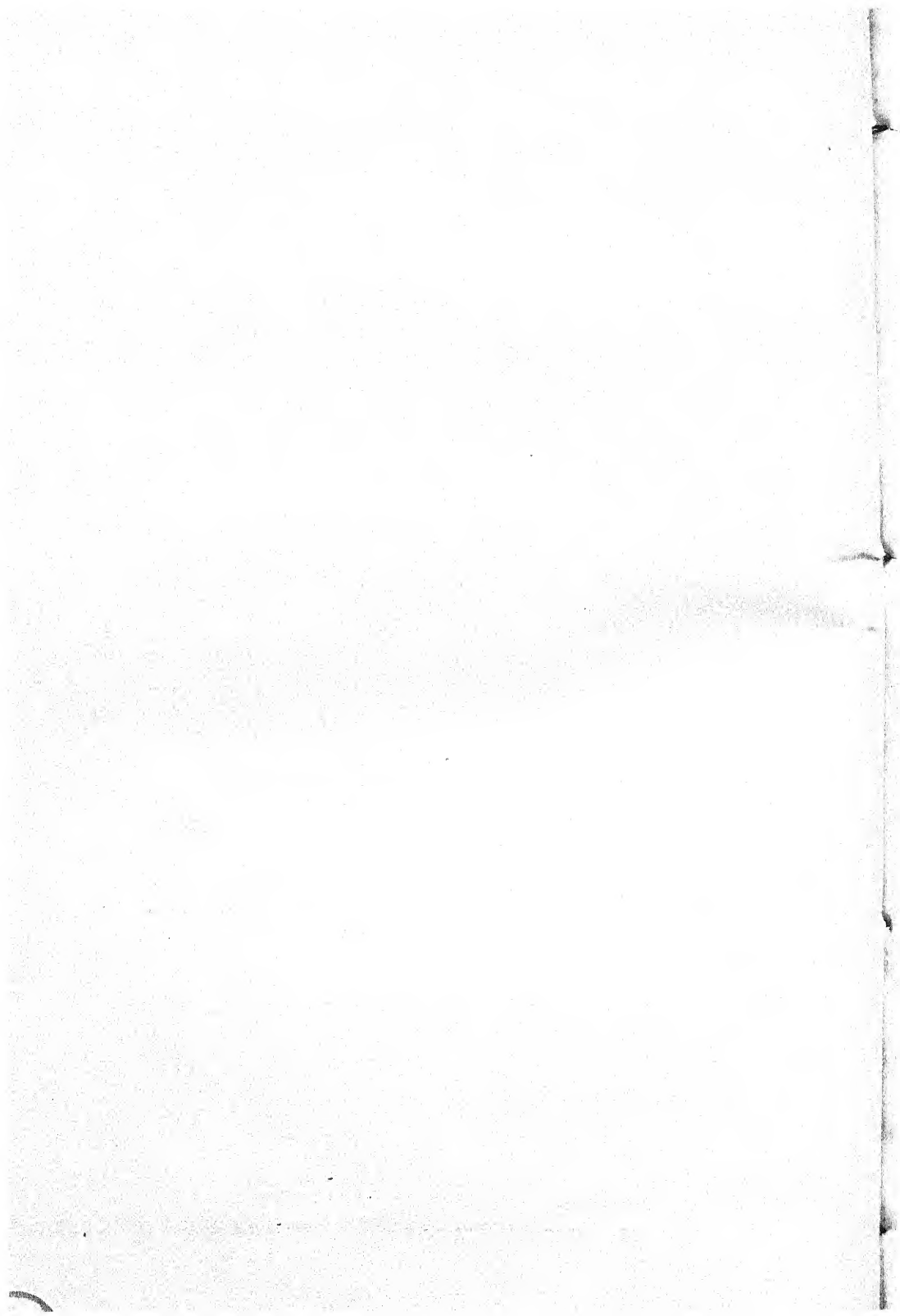
*Sus barbatus*  $\times \frac{1}{4}$

Comparative dimensions of skulls of *s. cristatus* and *s. barbatus* (average adult male).

	Upper length.	Basal length.	Least intraorbital breadth.	Zygomatic breadth.
+ <i>Sus barbatus</i> .	447 mm.	428 mm.	75 mm.	182 mm.
<i>Sus cristatus</i> .	361 mm.	323 mm.	74 mm.	155 mm.

+

The specimen sent by J. E. Kempe to the Raffles Museum in September 1921.



miles off the Johor coast where it is not usually an inhabitant, either by swimming or on drift wood. Such events are phenomena—so rare as to become almost historical, and need abnormal circumstances such as a great flood to produce. Such favourable conditions as this could not occur on the small islands of the archipelago. Still the swimming ability of the pig is not to be taken lightly, and they are known to cross from one adjacent island to another in the Riau group.

The floating 'islands' of vegetation which are such features of the Straits of Malacca at certain times (but not, it be noted, of the Eastern sea-board,) are also suggested vehicles of distribution. These have as their nucleus as a rule the nipah palm (*Nipa fruticans*) which grows in brackish water and is not securely rooted. Given floods or abnormal tides, fringes break off and drift out to sea. Sometimes they are a rood or two in area. That they sometimes carry such animal life in their wanderings as tree shrews and rats is undoubted. As vehicles for anything greater and heavier, these 'islands' have limitations and the transport of anything as big as a pig (or as sagacious) must be exceedingly rare. It is to be doubted if even the crab-eating monkey of the mangrove swamps (*Macacus cynomogus*) is often a passenger. The islands become waterlogged at sea, float half submerged for a time and eventually break up into fragments. It would be interesting to know what evidence there is, if any, of the larger mammals being found on one of these rafts.

As a potential agency in natural distribution, it is felt that this and the other phenomena referred to can be very easily over-rated. The conclusion drawn is that the presence of *barbatus* on the Peninsula is unlikely to be due to a fortuitous supply from outside, (leaving aside the possibility of a few individuals having been introduced by the abnormal agency referred to before), even by a series of most favourable but not easily imaginable circumstances.

It follows that this pig has been with us all the time and that for some as yet unknown reason, it has only revealed itself on a very few occasions. That it must be low in numbers and very local is unquestioned though why, it is not understood.

That again leaves the major problem of its position so far out of its accepted frame still unexplained. According to the east and west 'drift' theory of Indo-Chinese (Himalayan) species which entered Sundaland from the north, suggested by Chasen in his foreword to the list of Malayasian mammals (Bulletin Raffles Museum: Vol. 15: 1940), some reached Sumatra and turned north whereby the Peninsula fauna from the western drift received additions *Sus barbatus* may easily have been amongst their number. In which case some explanation is needed why it should have lingered on in such obscurity as it is thought to have done, to be rediscovered in isolated and far separated localities after long intervals.

The facts as at present known are incomplete and further careful search may yet reveal small colonies surviving, while a closer study of the Bearded Pig's habits and environment in Borneo and Sumatra may help to elucidate the reasons why it has virtually disappeared as a common feature of Peninsula fauna.

# AN ORNITHOLOGICAL PILGRIMAGE TO LAKE MANASARÖWAR AND MOUNT KAILÄS.

BY

SÄLIM ALI

(With a map and 7 plates).

The hallowed region of the freshwater lakes of Mānasaröwar and Rakhas Tal, and of Mount Kailäs in Western Tibet is virtually forbidden ground to Europeans. It is perhaps for this reason more than another that practically nothing has so far been recorded about its birds. The time-honoured legend about 'hansa'; ('Swans' according to pilgrims' guide books) living on Mānasaröwar somehow persists, and in the popular mind these birds have become inseparable from the sacred lake. But reliable published information concerning the general ornithology of this region is lacking, although some excellent papers have appeared within the last 20 years or so on Ladakh as well as on Eastern Tibet by Osmaston, Meinertzhagen, Ludlow and others.

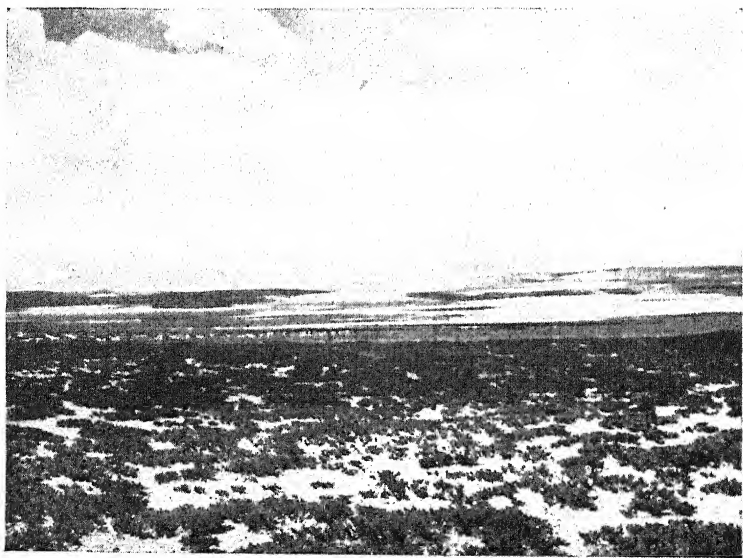
Mr. Frank Ludlow, who probably knows more about Tibetan birds than any other ornithologist living, made a small collection in Western Tibet in September-October 1932. The late Hugh Whistler pronounced it to consist of typical Tibetan Plateau forms, not differing from those occurring in Ladakh on the one hand or in the neighbourhood of Lhasa on the other. Ludlow never published any report of this trip, but has now been good enough to let me see his MS notes and to permit me to incorporate them in the present account. I consider it fortunate to be able to do so for 2 reasons: firstly because up to a point his itinerary coincided with my own, and secondly because his notes cover a period which is almost exactly complementary. Ludlow's trek was much more extended than mine, but I have here utilised only such of his notes as relate specifically to the region visited by me. While there is nothing novel or unexpected in the list that follows, it seems desirable to put this precise data on record for the benefit of future visitors.

What primarily attracted me to Mānasaröwar was the opportunity to study the natural conditions under which birds live on the Roof of the World, to ascertain at first hand what species breed in that area, and to determine if possible some of the ecological factors that foster their doing so. Although not interested in birds purely from what may be called the 'subspecific' point of view, I nevertheless feel it a great pity that practically no collecting could be done in an area that is so seldom visited by an ornithologist. I was advised by those who administered our External Affairs not to carry a gun to shoot birds with. Presumably it offends the religious scruples of the Tibetans to see birds killed by other people. None of these scruples were detected in the case of animals killed by themselves, and in a manner





Western shore of Mānasarōwar with Mt. Kailās in background  
(showing Shore or Beach zone)

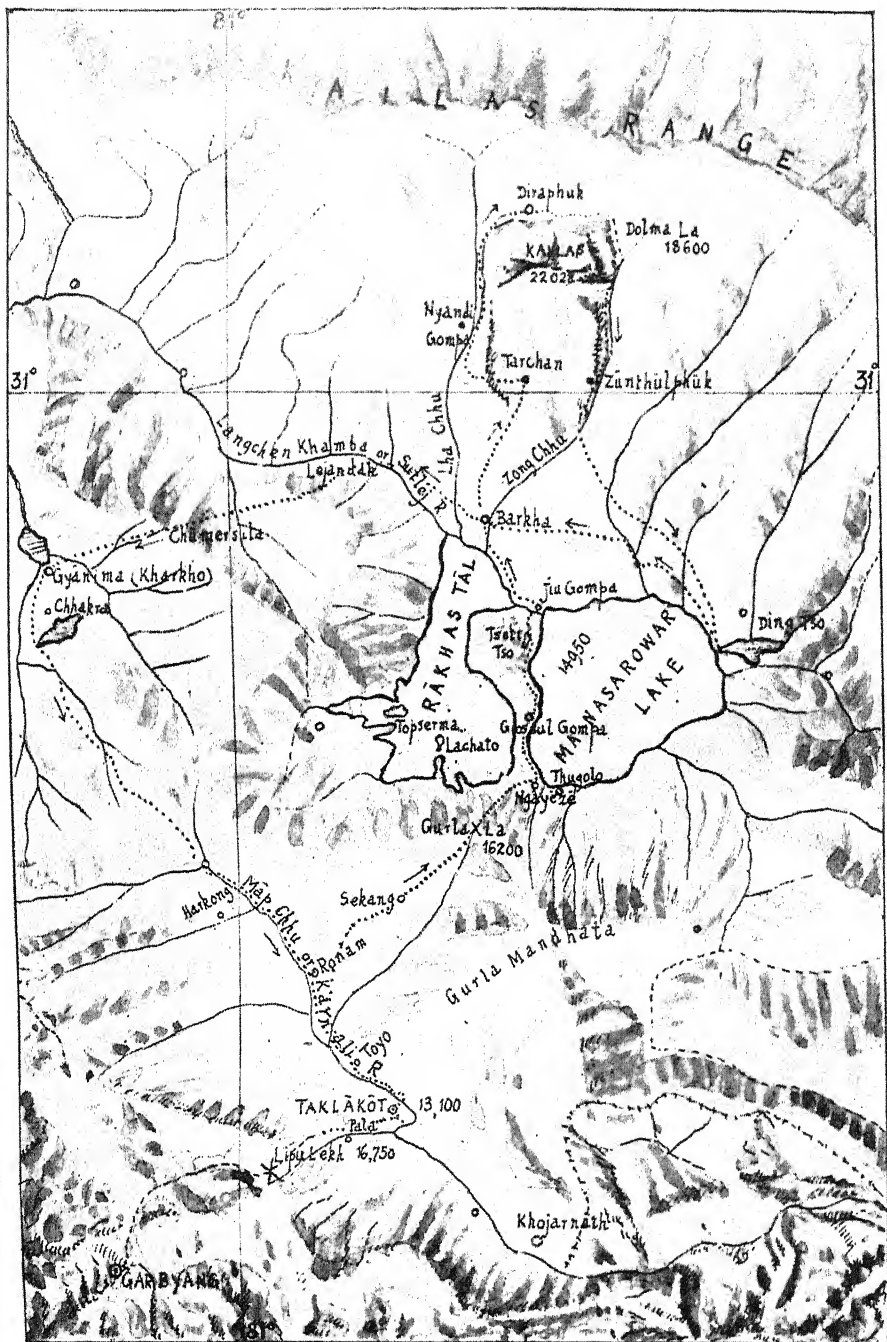


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Salim Ali

Rākhas Tāl with typical Kyang country in foreground





(After Heim & Gansser)

The Kailās-Mānasarōwar Region of Western Tibet

Scale 1" = ca 20 miles

Route.....

that would make shooting seem a kindness. However, that is another story. But in the absence of skins for verification, some of my identifications may have to be taken with reserve, particularly in cases where they are at variance with Ludlow's.

I must confess that I have seldom felt sorrier for being so law-abiding and following official advice. Not only was much valuable scientific material lost without a gun; not only would an occasional roast goose have provided welcome change from the eternal dāl and rice; but also the couple or ugly encounters with local bandits that infest the Manasarowar environs could have been faced with far greater self-composure and dignity! As it was, either of these might well have ended in disaster had the bandits suspected the astonishing truth (for those parts) that the party was completely unarmed.

To enable me to be there in time for the nesting, a start had to be made as early in the season as the snow on the Lipu Pass would permit. The pilgrim season proper does not commence until about August. My trek began at Almora on 14 May 1945 and ended at the same place on 22 July. Up to the Tibetan frontier, crossed on this route by the Lipu Lekh Pass at 16,750 ft., it is a matter of about 16 marches—nearly 160 miles. Baggage over the first 14 marches travelled cooly-back. The regular trace takes a north-easterly direction from Almora and passes through some picturesque Himalayan scenery with superb views from various places along the route of Nanda Devi, Nanda Kot and the Panch Chuli peaks. For more than half its latter length it follows the right bank of the torrential Kali River which forms the boundary between the Kumaon district of Almora and the kingdom of Nepal. At Lipu Lekh the Kali is run to its source. The trek, commencing at about 5,200 ft. altitude (Almora) goes through an unending series of steep ups and downs. The lowest point ever touched in the course of the 160 odd miles is 2,200 ft. where the path crosses the Gauri Ganga River. Thus it furnishes a cross-section through an altitudinal range of some 14,000 ft.—from the warm subtropical jungles of the Himalayan foothills through various climatic and vegetational zones, up to above the limit of tree growth. The accompanying changes in the bird life as one crosses from one altitudinal zone or stratum to another are often so clear-cut that using them as indicators one soon learns to hazard a fair guess of the approximate elevation even without the help of the aneroid. It is this constant change of levels and the meetings and partings with new or familiar birds that to my mind makes trekking in the Himalayas so particularly delightful.

On 8 June the Lipu Lekh Pass was still under fresh and fairly deep snow. It had to be crossed in the unearthly hours of the morning while the surface was still hard and passable for the baggage ponies which had replaced the porters at Garbyang. After groping our way uncomfortably over boulders in pitch darkness with the dubious help of 2 miserable electric torches, the summit of the pass was reached at 6.15 hours just as the sun peeped out from over the barrier of mountains to the east. Here, among the cairns or piles of Mani stones, contributed laboriously

one by one by grateful pilgrims and wayfarers (such as mark the head of every mountain pass in Tibet) was my first meeting of the trip with the Robin Accentor (*Prunella rubeculoides*). The birds—two or three—were delightfully tame; they hopped unconcernedly on the snow within 4 feet of our cavalcade, picking up food. This was also my first introduction to the amazing confidence and complete lack of fear that was henceforth to be experienced from almost every species of bird in Tibet. Such behaviour came strangest of all from the Bar-headed Geese and Brahminy Duck which, as every shikari knows, are amongst the wariest and most wide-awake of our waterfowl in their winter quarters in India.

Immediately across the pass the character of the country, now Tibet, changed abruptly. Trees of course are non-existent here, but other vegetation was also exceedingly scanty wherever the dry stony slopes were free from snow. Only small patches of low shrubs of Doma or Tibetan Furze (*Caragana spinosa*) clung here and there to the mountainsides, otherwise completely bare and scree covered. The route from Lipu to Taklākōt runs all down the right bank of the river—the opposite number of the Kali, as it were—which rises on the Tibet side of the pass, the latter being the watershed. This river descends in a gently winding course for about 4,000 ft. in the 12 odd miles to Taklākōt where it joins the Māpcha or Karnāli. The latter, after flowing a great part of its length through Nepal territory in a N-S direction joins the Gogra in the Khēri District of the U.P. just south of the Nepal boundary.

Taklākōt or Purang (ca 13,000 ft.), the first village of any size to be encountered, is a large and important *mandi* during the summer months. Traders from all parts of Tibet as well as from British India foregather here between June and November to barter wool, furs, borax and other indigenous produce with cloth and other articles of civilisation which appear to have a growing demand. Among these I noted as part of the standard stock-in-trade of Indian shops: cheap electric torches, new and second-hand army boots and plinosles, packets of tea from Lhasa and Berenag, sugar (misri), pots of highly scented vaseline pomade, safety pins and a miscellaneous assortment of tawdry nick-nacks requiring a high degree of imagination on the part of the shop-keepers.

One of the first indications that one has left Indian soil and is now in a different ornithological region is provided by the pigeons, which here suddenly change over to the Turkestan Rock Pigeon (*Columba rupestris*). This species is easily distinguished from our familiar Blue Rock by its whitish underparts and a broad white bar across its tail. Flocks of these birds were to be seen gleaning in the fields of young barley and gram surrounding the village. A few often visited our camp to pick up what grain they could round the kitchen tent. They were as tame and trusting as their pampered relations in the midst of Bhulēshwar (Bombay) for example, and other centres of Hindu benevolence.

The Tibetan Raven (*Corvus corax tibetanus*) takes the place of Jungle and House Crows as the village scavenger, though it is seen

in smaller numbers. Skylarks—apparently *Alauda gulgula lhamarum*—were soaring and singing plentifully above the cultivation, while Red-billed Choughs (*Pyrrhocorax pyrrhocorax*) grubbed away merrily on the outskirts. The House-Sparrow—presumably *P. d. bactrianus*—was here in some numbers, but not as abundant as I was to find it on the return visit a month later.

At Taklākōt the 6 baggage ponies were exchanged for 4 yaks. And here a short digression may be permissible. The yak is an extraordinary beast. From in front it looks like an overgrown bear; from behind like a very shaggy hill pony. It possesses boundless energy, and seems impossible to tire out except when the weather is hot. It is highly sensitive to and impatient of the heat which seems to be the only element that will ever lower its spirits. At the end of a long fatiguing all-day march, carrying on their backs 2 maunds (160 lbs.) of often the most angular and uncomfortable load, and with just a few mouthfuls of scanty grass snatched while we halted for the mid-day meal, our yaks would frisk and romp obviously feeling 'as fresh as a daisy'. It was disconcerting when ebullience of spirits prompted one to buck and throw your baggage—boxes containing delicate and precious meteorological instruments that, moreover, didn't belong to you! A bridge is anathema to the yak. It is not every animal that will walk over it. Neither is it every day that even the same yak will consent to walk over one. There may be some justification for its preferring to leap into an icy cold torrent and swim across rather than use the highly unconvincing rickety wooden structure swaying perilously above it. One is frequently tempted to do so oneself. But the soaking is not always beneficial for your baggage, particularly when this happens to be your bedding or warm clothes. Luckily bridges are few in Tibet. The yak has an unpredictable temperament, and you never know beforehand how one is going to react to any given set of circumstances.

The mountains here are chiefly composed of conglomerates—large quantities of rounded water-worn shingle cemented together with clay through age and pressure. Large detached blocks littered on the hillsides that look like enormous boulders in the distance are also composed of the same conglomerated clay and shingle, reminding one of chunks of almond rock. All the way from Taklākōt to Mānasarōwar the country is flat stony desert, the ground surface being chiefly covered with smooth water-worn stones, shingle or gravel—partly disintegrated from the mountains. Broadly speaking it is a titanic undulating steppe mostly between 14 and 15 thousand feet above sea level, extending miles in every direction and fringed on the near or distant horizon by snowy ranges and peaks. The enormous flat or gently sloping areas from the foot of the Gūrla Mandhāta Range to northward bear evidences of becoming vast snow-fields in winter. The stones, gravel and shingle on them are flattened down as by a steam roller. A curiously similar formation was noticed by me on the hills around Chāduva in Kutch (1943) but the stones there were all flat like paving slabs. What can that be due to?

From time to time flat-sided trough-like valleys are encountered as of glacial origin running down from the flanking hills. Through

these meander rivulets from the melting snows higher up. About the banks of these rivulets, where the snow has melted, there is usually some scant herbage—a narrow strip of it on either side. This is the only green to break the drab and endless monotony of the stony landscape. The few birds that there are, concentrate in such places. Occasional low dense bushes of Doma or Tibetan Furze on the plateau, either isolated or scattered in patches, provide the only relief to the eye. They are sprawling and round-topped, like large hedgehogs, streamlined on their periphery near the ground. Dotted about on a gentle slope in the distance, they often look like a flock of grazing sheep.

A very characteristic facies of this region is that which occurs in the flat open valleys sloping so imperceptibly as to impede drainage and cause water-logging. At the season of my visit (first half of June) these showed traces of having been enormous snow-fields till recently, and extensive patches of snow were still lying about here and there. Where the snow has melted is often exposed a varying extent of semifloating spongy uneven humps, up to 12 inches high, covered with what looks like close-cropped lush grass. Such areas become tundra-like bogs. In portions the humps though green and refreshing are comparatively dry. In other parts the ground is completely soggy and water-logged, and they are in effect an archipelago of miniature islands or aits.

Almost everywhere around such tundra bogs the Lesser Pamirs Sand-Plover (*Charadrius mongolus atrifrons*)—familiar to us in winter on the western seaboard in flocks and now in his handsome summer dress—was sure to be met with. Surrounding these bogs there is usually a luxuriant growth of furze 'hedgehogs' which afford some protection from the violent winds and are much patronised for nesting in by Robin Accentors, Rubythroats and Tickell's Willow-Warblers. Everywhere on the stony gravelly plateau, even in the barest and most featureless spots, the Horned Lark (*Eremophila alpestris elwesi*) was breeding in great abundance. It has remained a puzzle to me why this bird chose the bleakest spots for its nest and what considerations decided the selection of a site. It seemed completely unperturbed by the wind and its nests were usually in the most exposed places. Occasionally they were near a tiny stone, it is true, but I am inclined to think that, if anything, this served more as a landmark to the bird than as an effective wind-break.

Immediately on crossing the summit of Gurla Pass (16,500 ft.)—wide and flat enough I imagine, for 200 Churchill tanks abreast—the first view is obtained, glorious and breath-taking, of the twin lakes of Mānasarōwar and Rākhas Tāl with the ice-covered dome of Mt. Kailās towering in the distant background to the north. The lakes are separated by a ridge of low hills forming an isthmus, 3 or 4 miles at its widest. Along this lies the route to Barkha Plain and the holy mountain.

My first camp on Mānasarōwar was pitched at Ngāyozē (ca 15,200 ft.) on the S-W shore of the lake. The water surface of Mānasarōwar is 14,950 ft. above sea level. It is 54 miles in circumference and surrounded on all sides by mountains, many of them well over 20,000 ft. high with snow-covered tops. The

greatest depth sounded by Sven Hedin in 1907 was 269 ft. The colours on the lake, changing not only with time of day but with every fleeting mood of the sky are a thing undescribable, and not likely ever to be forgotten. From almost snow-white, may be, at one end, it ranges to every imaginable shade of green and blue—and from the deepest jade and the purest emerald to intense ultramarine blue and purplish-black.

A scrutiny of the terrain on the southern and south-western shores of the lake reveals an interesting range of successions. There are no reedbeds at all about the margins of Mānasarōwar or Rākhas Tāl, or indeed of any of the other lakes visited.

At the water's edge is a flat Shore or Beach zone of sand and shingle; higher up this gives place to a wider zone (in places 2 to 300 yards wide) of 'tundra' bog as described—spongy water-girt humps interspersed with small pools. Above the tundra zone follows another wide belt, of dense furze hedgehogs formed by a windblown accumulation of debris caught up in the bushes resulting in raised mounds at their core. These sprawling hedgehogs are 18 to 24 inches high and sometimes cover the ground so thickly as to hinder one's progress. Beyond the furze zone the flat bare ground is covered with loose stones and shingle, flattened down to evenness by the weight of the overlying winter snow. It stretches upward in a gentle sweep for 1 to 1½ miles, to the base of the Gūrla Mādhātā Range. The Shore and 'Tundra' zones, particularly where they meet, are riddled into a sieve with holes and galleries of voles and mouse-hares. As can be imagined, these four zones are not clear-cut or sharply demarcated along their boundaries and frequently dovetail into their neighbours, but they are distinct enough to be perceived without difficulty. With the exception perhaps of the Beach zone—a speciality of Mānasarōwar and Rākhas Tāl—the same order of succession with minor local variations is met with also on the smaller lakes: Ding Tso, Tseti Tso, Gyanima Tso, and others.

Adam's Mountain Finch (*Montifringilla nivalis adamsi*) as well as its two cousins *M. blanfordi* and *M. ruficollis* were everywhere taking full advantage of the rat holes as nest sites, and quite a few were observed carrying food into them. The tundra around the lakes seemed to be breeding ground *par excellence* of the Large Calandra Lark (*Calandra maxima*). Hundreds of these birds were busy courting, chasing one another, singing and nest-building round Mānasarōwar, Tseti Tso, Ding Tso and Gyanima Tso. Short-toed Larks (*Calandrella acutirostris*) were also present in the tundra zone at Mānasarōwar in large numbers. This was somewhat puzzling at first, but it was soon discovered that they visited the bog merely for collecting insects for their young, and flew off with beakfuls long distances to the bare stony country above the furze belt where they were nesting.

The principal inhabitants of the Furze zone were the Ruby-throat (*Calliope*), Robin Accentor (*Prunella rubeculoides*) and Tickell's Willow-Warbler (*Phylloscopus affinis*). Higher up, on the stony and gravelly plain, Horned Larks and Short-toed Larks were nesting abundantly, and the jolly little Hume's Ground Chough frequently seen.



At the time of my visit to Mānasarōwar and Rākhas Tāl the snow had not been gone long, and it was as yet too early in the season for the lush grass which is said to spring up luxuriantly on the moist areas later—mid July or August. Great herds of goats, sheep and yaks are then brought here for pasture from distant parts.

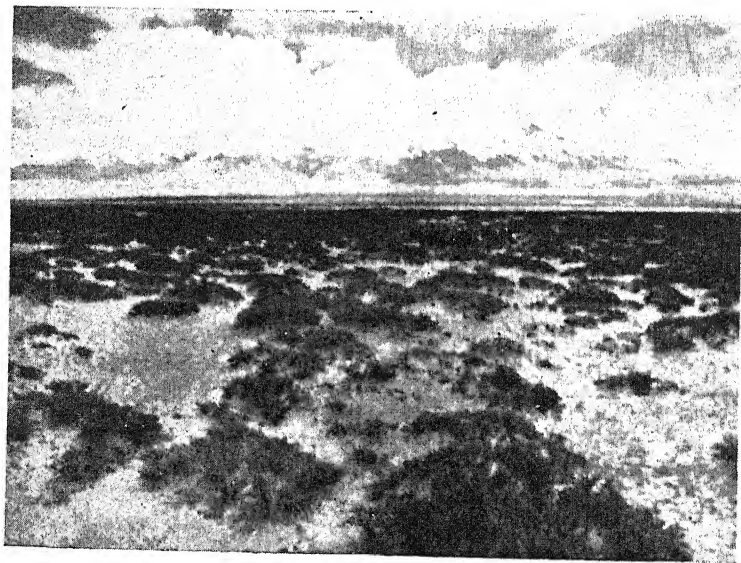
Curiously enough, except for an occasional sand-plover or two, no waders at all were to be seen at the water's edge in the Shore or Beach zone of Mānasarōwar. Their place appeared to be filled by Brandt's Mountain Finches (*Fringilla brandti haematopygia*). Hundreds of these birds ran about the water-line looking very like stints, busily picking seeds washed up by the ripples. Sometimes the birds were in ones and twos, but mostly in flocks of 50 or more. They had evidently not commenced to breed as yet.

Of the waterfowl Bar-headed Geese, Brahminy Duck and Goosander were the most prominent representatives, the first two in considerable numbers. The geese, it seemed fairly certain were not breeding in the immediate neighbourhood. Their favourite nesting ground is on two boggy islands in the Rākhas Tāl, but without a boat it was not possible to explore these. A mixed flock of over 50 duck was observed on the water as they flew over, but it was difficult to tell with certainty what they were besides the few Gadwal and Pintail which were unmistakable. They were evidently not meaning to breed here either. Crested Grebes were abundant and numbers of their floating nests dotted the water some distance from the shore, particularly on a small lagoon by the side of the main lake. Brown-headed Gulls, Tibetan Terns and a couple of Pallas's Fishing Eagles practically complete the list of birds seen about the southern end of Mānasarōwar Lake.

The Barkha or Parkha Plain which separates the Mānasarōwar and Rākhas Lakes from the Kailās Range to the north, extends for many miles in an E-W direction. It is a gigantic highland steppe or flat valley covered for the most part with gravel and scanty scraggy grass at present. It is said to afford rich pasture later in the season, especially along the banks of the many streams that leisurely meander across it on their way from the Kailās Range to Rākhas Tāl. Along the northern edge of the Barkha Plain the ground slopes gently southwards in a gigantic sweep from the base of the Kailās Range. This sloping zone, several miles in width, is covered more or less densely with bushes of Doma or Tibetan Furze. Its surface consists of soft loose sand in places, and in others of coarse river sand with stones and shingle intermixed. It is cut up here and there by deep or shallow ravines of streams coming down from the Kailās Range. The sandy Doma-facies is strongly reminiscent of bits of the Indian Desert in Sind or Kutch, only the *Capparis* of the latter being here replaced by furze. The windblown sand is arrested in the same way by the furze bushes and forms compact mounds, but seldom higher than 12 or 18 inches. This facies, particularly in the environs of Rākhas Tāl, is the favoured habitat of the Kyang (*Equus*) which flourishes in large herds of up to 100 or more. The Barkha Plain can be differentiated into several other facies



Barkha Plain  
Dry bogland and gravel facies



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S. M. Ali

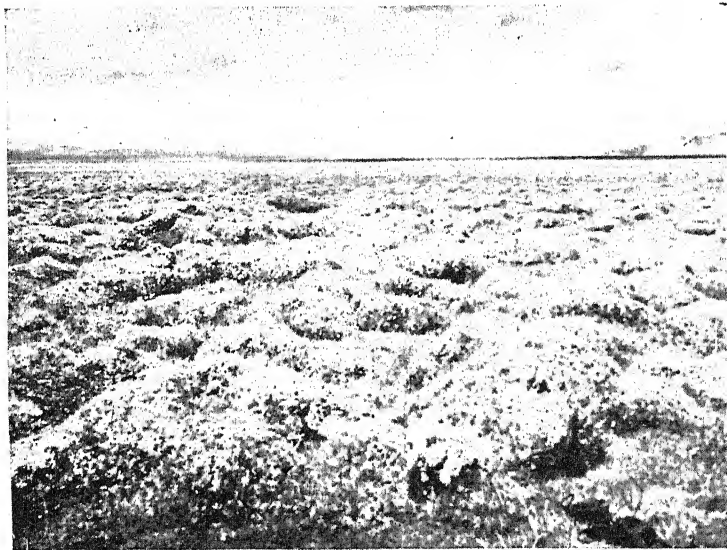
Barkha Plain  
Sandy *Doma* facies





Ding Tso

Breeding place of Brown-headed Gulls, Tibetan Terns, Redshanks,  
Black-necked Cranes, Eared Grebes, etc.



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Sâlim Ali

A typical ' tundra ' bog—Gyanima Tso  
Breeding ground of Bar-headed Geese, Large Calandra Larks, etc.

besides: Loose-sand covered with sparse grass; coarse, roughly waterworn gravel and stone; and dry bogland. The last consists of uneven dips and mounds of crumbly earth reminding one of old worn-down flamingo nests.

Marching over the plain, one is constantly crossing from one into another of these facies. Wherever near a stream or its flat overflow, i.e. ground actually moist or till recently water-logged, it is honeycombed by mouse-hares to such an extent that one of the baggage yaks suddenly sank down to its belly. *Montifringilla blanfordi*, *M. ruficollis* and *M. nivalis* are invariably present in such facies to take advantage of the potential nest-sites. The birds and rodents evidently live together amicably. I observed a finch go down a burrow with food for young, followed soon after by a mouse-hare. Young finches when fledged, but while as yet unable to fly, come out of the tunnels and sit about and hop among the mounds where the parents feed them. On alarm they bolt down the nearest rat-hole and are evidently not molested by the occupant within.

In the flats formed by what may be called the deltas of the streams before they discharge into the Mānasarōwar and Rākhas lakes, the Doma gives place to extensive patches of a greyish-green bush about 12 inches high, known in Tibetan as *Tarwa* and in Kumaoni as *Chookoo*. These bushes apparently die down in winter and were just beginning to come up again (in June) on the melting of the snows.

The official pilgrimage of Mount Kailās begins at Tarchan or Darchan (alt. 15,500 ft.), a ramshackle village of a few hovels of piled-up loose stones, with a Gompa or monastery and attendant filth as its centre-piece. It also boasts of a small *mandi* open in summer but now lying derelict. The circuit of the holy mountain is 28 miles round and involves the crossing of a pass (Dolma La) 18,600 ft. high. Furze growth peters out at about 16,000 ft. and above this elevation perennial vegetation is practically non-existent. Bird-life along the entire circuit—in fact above 15,000 ft. altitude—was poor, but this may partly be due to the fact that I was much too early in the season. Places that had been recommended to us as rich alpine pastures and flower meadows were as yet little more than bleak and desolate snowfields dotted with recently melted patches here and there where the first hesitant spring herbage was beginning to peep out.

Except for Redstarts which were particularly abundant and nesting among the scree fans near Diraphūk or Diripu, a few pigeons and ravens about the Gompa there, a Robin Accentor with nest and eggs on the edge of a partly frozen stream, several Red-billed Choughs, and a couple of Himalayan Griffons and Lämmergeiers beating majestically over the hillsides behind the monastery, practically no birds were seen. A couple of pigeons were encountered on the very summit of Dolma La, attracted there by the grain sprinkled according to custom by pious jātris in thanksgiving for the culmination of the arduous climb.

The Lha Chhu and other part-frozen streams on the holy circuit looked ideal for White-capped and Plumbeous Redstarts, but these familiar Himalayan species were completely absent. On

the Tibet side of Lipu Lekh Pass I also failed to come across the Whistling Thrush, so common along the Kāli River on the Himalayan side, almost right up to its source.

Horned Larks nest on the Barkha Plain in great profusion, both in completely barren and desolate spots as well as where there is a scanty growth of stunted turze. Short-toed Larks are more partial to the latter facies. Ground Choughs, Tickell's Willow-Warbles and Redstarts evidently prefer the side valleys where earth banks for nest-holes are readily available, and where there is more protection from the ferocity of the regular diurnal winds.

The Ding Tso lake proved a particularly fruitful place for birds. From the cosy comfort of the sleeping bag, and without raising my head from the pillow, could be watched through the open fly of the tent almost any time of day, numbers of geese, cranes and Brahminies as they sauntered about and grazed complacently on the grassy margins of the lake and in the surrounding marsh, within easy shot-gun range. My diary records: 'Delightful, but oh for a .22 and roast goose on the menu!' Along its eastern and northern shores is an extensive tundra belt 3 or 4 miles long and in places fully  $\frac{1}{4}$  to  $\frac{1}{2}$  mile broad. Many of the uneven spongy humps here are actually floating, and separated from each other by a good long jump over deepish water. One had to be nippy and constantly on guard lest the hump underfoot should disappear below the surface before one had time to jump across to the next. It was an uncomfortable and flustering feeling to find oneself suddenly down to the waist in ice-cold water and sinking steadily. It was necessary to plan out several jumps in advance, and decide quickly. And the possibility of quicksands here and there—against which I had been warned—added to the excitement of the game. However it was fascinating work, and the exploration of this marshy belt proved well worthwhile. I found breeding here not only Bar-headed Geese and Black-necked Cranes, but also Brown-headed Gulls, Tibetan Terns, Redshanks, Crested Grebes and Large Calandra Larks.

#### METEOROLOGY

To this sketchy and imperfect account of the country might perhaps be added with advantage a few notes on the meteorological conditions experienced in June.

*Temperature:* The minimum night temperatures varied between 28° and 38°F. inside the tent, being mostly in the neighbourhood of freezing (32°F). The maximum day temperature registered was 89° in the shade (once). Normally it ranged between 70° and 75°. In the sun it was often uncomfortably hot even without a woollen vest or jersey on, but liable to become chilly with great suddenness as soon as a cloud obscured the sun. These violent fluctuations, from roasting one moment to freezing the next, always made it difficult to decide how one should be clad for a march. Pull-overs had to be handy in the rucksac, and quick changes by the wayside (sometimes several in the course of a day) were not uncommon. Practically every day of the month the sky was

party to heavily overcast for some part of the 24 hours, and light drizzle or hail (snowfall on one or two occasions) were frequent.

*Barometric Pressure:* This showed appreciable variation at the same place, and was frequently as much as 4 millibars higher in the morning than in the evening.

*Wind:* Except on a few memorable occasions when the blowing away of the tent from above our heads was all but imminent, the nights were comparatively windless. But except for a few comparatively windless days which could probably be counted on the fingers of one hand, the wind sprang up with great regularity soon after about 10.00 hours each day—occasionally after 14.00 or later—and raged and howled until 19.00 to 21.00 hours when it as suddenly died down. And what a wind it was too! Visitor after visitor to Tibet has execrated the fury of the diurnal gales, and with good justification. My weather diary records the normal velocity as No. 5 or 6 of the Beaufort Scale (i.e. between 17 and 27 miles per hour) and occasionally even No. 7 (28-33 miles) the latter causing considerable inconvenience in walking against.

Observations of humidity were also taken with a revolving Hygrometer, the lowest and highest figures recorded in Tibet during the entire trek being 26 and 89. All the data, meagre as it is, has been forwarded to the Government of India Meteorological Office in Poona, to whom I wish to express my thanks for their co-operation in loaning out the necessary apparatus.

#### *Itinerary:*

- 8-6-45. Lipu Lekh Pass (16,750') to Taklaköt.
- 9-6-45. Taklaköt or Purang (ca 12,700').
- 10-6-45. Rangūng (ca 14,300').
- 11-6-45. Sekang (ca 15,300').
- 12-6-45. Sekang.
- 13-6-45. Ngāyēzē (ca 15,300')—S-W shore of Lake Mānasarōwar.
- 14-6-45. Halt at Ngāyēzē
- 15-6-45. Ohheting or Tsering Madāng (15,000')—8 miles up W shore of Mānasarōwar. Camp by Tseti Tso.
- 16-6-45. Jiu Gumpa (15,000') North end of Mānasarōwar. Camp by Ganga Chhu—the channel connecting Mānasarōwar with Rākhas Tāl.
- 17-6-45. Barkha (ca 15,100').
- 18-6-45. Tarchan (ca 15,500') S of Mt. Kailās.
- 19-6-45. Diripu or Diraphūk (ca 16,700')—N of Mt. Kailās.
- 19-6-45. Halt at Diraphūk.
- 20-6-45. Zūnthūlphūk (16,000')—E of Mt. Kailās, beyond Dolma La Pass 18,600'.
- 22-6-45. Halt at Zūnthūlphūk.
- 23-6-45. Pelūng Yōma (ca 16,000')—side valley on N edge of Barkha Plain.
- 24-6-45. Ding Tso Lake (ca 15,200')—at N-E corner of Mānasarōwar.
- 25-6-45. Halt at Ding Tso.
- 26-6-45. Kyāngma (ca 15,200')—near S edge of Barkha Plain.
- 27-6-45. Lha Chhu (ca 15,200')—Barkha Plain west of Barkha.

- 28-6-45. Lējandāk (ca 15,000') also pronounced Lālenthāk. On S edge of Barkha Plain with a sprawling arm of Rākhas Tāl along the base of the low bare hills, and with tundra belt bordering it.
- 29-6-45. Chhūmersīla (ca 15,000'—pronounced Chhū-mi-shīla).
- 30-6-45. Gemoshīsa (ca 15,100')—overlooking Gyānima Tso (lake) ca 3 miles to S.
- 1-7-45. Gyānima Mandi or Khārkho (14,900')—with many square miles of tundra bog around Gyānima Tso.
- 2-7-45. Gyānima Chhakra (14,900').
- 3-7-45. Shēlēkhookar—across Chhakra La or Chuppu La (ca 15,000') N to S.
- 4-7-45. Māpcha Chhūngo (ca 14,400')—source of Māpcha or Karnāli River.
- 5-7-45. Rōnām (ca 13,400')—on left bank of Karnāli River. Down the Harkang 'lūmbo' (or river valley) luxuriant Doma on both banks of stream. Rubythroats nesting here in such abundance that I named it Calliope Valley. Also *P. affinis*. About 5 miles above its junction with the Karnāli, i.e. from about 13,800' downwards, *Saxicola torquata* re-appeared, now mostly accompanied by squamated young ex-nest.
- 6-7-45. Taklākōt. Route N to S all down the left bank of the Karnāli.

NOTES ON BIRDS OBSERVED IN THE MANASAROWAR-KAILĀS  
REGION OF W. TIBET 8 JUNE TO 8 JULY 1945

**The Tibetan Raven.** *Corvus corax tibetanus* Hodgs.

In small numbers—sporadic solos and pairs—scavenging in the precincts of monasteries or shepherds' encampments and 'goat-train' halting stations. Highest met: 16,700 ft. (Diraphuk, north of Kailās). In overhead flight the remiges look slate coloured, boldly set off by the jet black underwing coverts. Has a high-pitched voice. Its caws sound very like the call of the Tibetan Tern—*Kreeuk*—and they are varied by a soft *Pruk-pruk* etc. like a wooden cattle bell. Altogether quite an elegant performance for one of the tribe!

[Taklākōt, Barkha, Darchan. September 1932 F. Ludlow.]

**The Yellow-billed Chough.** *Pyrhocorax graculus*.

The only examples seen were a couple at 16,000 ft. just across the Lipu Lekh Pass, in the main Himalayan range. In the mountain ranges further north, e.g. Mandhātā and Kailās, it appears to be completely replaced by the next species.

[Not seen in W. Tibet. September 1932 F. Ludlow.]

**The Red-billed Chough.** *Pyrhocorax pyrrhocorax*.

Not uncommon but sporadic. Mostly pairs in early June, family parties early July. Young birds have brownish-red bill and pinkish gape. On cliffs, about cultivation and monasteries, by shepherds' encampments and goat-train bivouacs. Highest met: 18,000 ft. (near Dolma La, Kailās). Once a flock of over 50 attending large herd of Kyang miles out on the bare Barkha Plain. Call: a shrill cawing *Chiaow*, *chiaow* etc. An adult pair with two full-fledged juveniles observed retiring to roost in crevice of cliff—evidently nest-site—at sunset while still very light.

[Lipu Lekh, Taklākōt, Darchan. September 1932 F. Ludlow.]



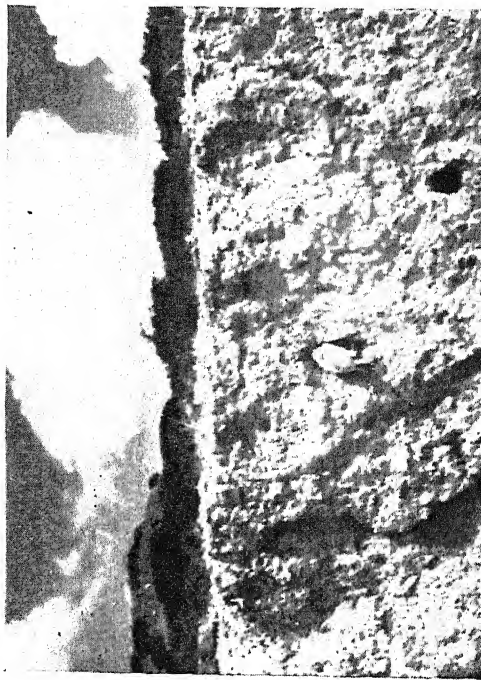
Red-billed Chongh



Selim Ali



Tibetan Raven

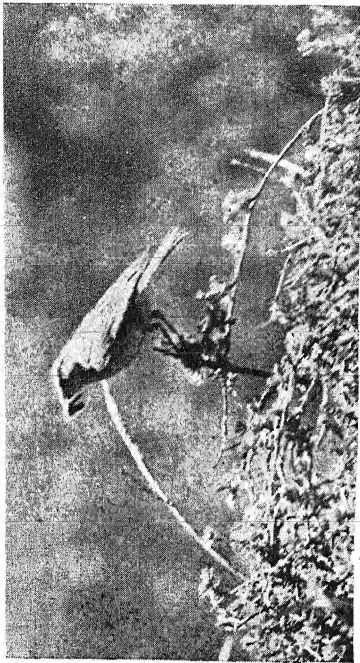


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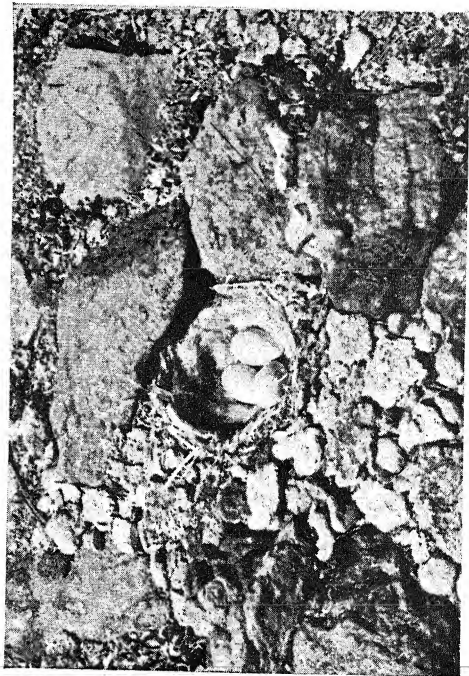




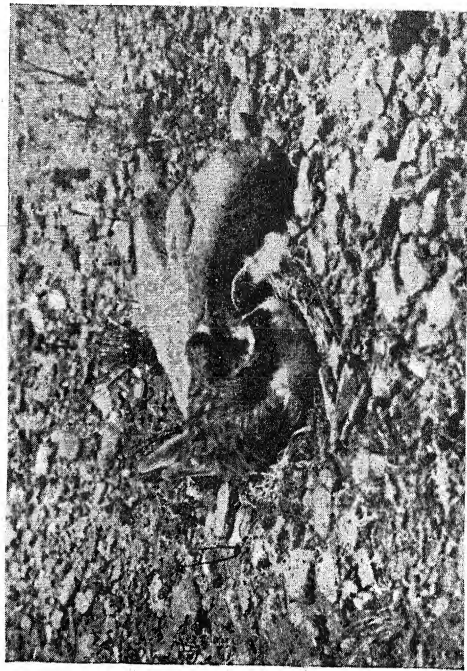
Redstart



Tickell's Willow-Warbler



Nest and Eggs of Short-toed Lark



Horned Lark (♀) on nest

**Hume's Ground Chough.** *Pseudopodoces humilis* Hume.

Quite common, generally in pairs or family parties of 4 or 5. Certainly one of the commonest birds in the Manasarōwar-Barkha area. Highest met: ca 16,000 ft.—i.e. the limit of furze growth. Evidently commencing to breed early. Frequents screes or stone littered gentle hummocks and lower hillsides in preference to the bare open plain. Partial to the side valleys opening on the Barkha Plain, and here to dry watercourses with steep outscoured earth banks. Hops about amongst loose littered stones, pulling them over with its curved bill or digging vigorously for insects. Mounts a stone every little while, or occasionally a furze hedgehog, to bob violently a couple of times like a chat, but standing upright and not ducking its head. General appearance very like the Mountain Finch (*Montifringilla n. adamsi*) with the same colour pattern of tail—white outside feathers, brown middle ones—but no white wing bar. Twitches tail open laterally every now and again, and also shivers wings, especially while bobbing. The flicker of the white tail feathers in the distance is often the only indication of the bird's presence in its obliterating environment. Progresses on the ground with an upright carriage in long hops, bouncing like a rubber ball. When rummaging or digging among the stones, and also in flight (when the tail is spread exhibiting the white-and-brown pattern,) the bird reminded me strongly on the Large Grey Babbler (*Argya malcolmi*). The likeness is heightened by the slightly curved bill and the darkish lores. In other ways the bird is reminiscent of the Wood Shrike (*Tephrodornis pondiceriana*). Calls: The *Chip-cheep cheep cheep cheep* commonly uttered, is very like call of the Yellow-eyed Babbler (*Chrysomma sinensis*). There is a slight pause after the initial *chip*; the rest of the notes are quick-repeated. It also has a feeble whistling note like that of the Spotted Munia, but more prolonged.

Nesting: Nests in holes in earth banks, self excavated. One nest (22 June) was at the end of a horizontal straight tunnel in a steep earth bank 4 ft. long, and 3 in. in diameter. The tunnel ended in a widened chamber 9 to 10 in. across. The nest itself was an enormous pad of sheep's wool on a foundation of green moss and weighed over 1½ lb. It contained a clutch of 6 eggs, slightly incubated, immaculate white with translucent pinkiness, longish ovals only slightly narrower at one end. They measured: 23.5×17, 23×17, 24×17, 24×16.5, 24×16, 23.5×17 mm. At another nest containing young (24 June) both parents were observed entering with food and removing packets of faeces.

The bird does not alight outside the nest-hole before entering but 'helicopters' into it directly, vibrating its wings rapidly as it approaches the hole. For photographs the hole had to be temporarily blocked with a stone.

From much in its general get-up, habits and behaviour I should not be greatly surprised if a proper anatomical study revealed the correct taxonomical position of this bird to be in the Family *Timaliidae* (Babblers).

[Darchan, Diraphuk. September 1932. P. Ludlow.]

**The Rock Nuthatch.** *Sitta neumayer*.

I had a distant fleeting glimpse of a bird at 18,000 ft.—below Dolma La Pass—which may have been either this or *Tichodroma*. I set down the record here for what it is worth.

**The Wall Creeper.** *Tichodroma muraria*.

A pair observed on steep conglomerate crags flanking the river at Taklakot (13,000 ft.). The flight consists of flap—pause (with wings closed)—flap—pause, and so on; very butterfly like. In the distance, in uncertain light, general appearance confusingly like Rock Nut-hatch, both when creeping up a rock-face and on the wing.

**The Brown Dipper.** *Cinclus pallasi*.

A single bird on Karnali River at Rōnām, 6-7-45.

**The White-breasted Dipper.** *Cinclus cinclus*.

A solo on the partly frozen Lha Chhu at Diraphuk (16,700 ft.), and a pair in copula at Zūnthūphūk (16,000 ft.)—both in the Kailas Range.



**The Collared Bush Chat.** *Saxicola torquata*.

Observed at Ngāyēzē (ca 15,300 ft.—S.W. shore of Mānasarōwar), in the Harkang Valley (between 13 and 14,000 ft.) and a Rōnām. Numerous in Harkang Valley. Chiefly on and about water-logged ground. With squamated wobbly flying young in first week of July.

[Specimen from 'Rugong' (? Rangung) 5 September. *S.t. przewalskii* F. Ludlow.]

**The Tibetan Desert Chat.** *Enanthe deserti* [*oreophila* (Oberholser)].

Observed at Taklakot, Toyo, Gurla Pass, Gossul Gumpa, (W shore of Mānasarōwar), Lejandak, Ding Tso, Kharkho, Gyanima Chhakra. Highest ca 16,500 ft.

Not noted at all on Kumaon side of Lipu Lekh, from Almora.

Solos and pairs. Sporadic but frequent. Keeps to stony hummocks and hillsides covered with sparse furze bushes. Male has a pretty little song: *Teee-ti-ti-ti* repeated monotonously all day long in the vicinity of the nest, from a stone or on the wing. Occasionally hovers about 50 ft. up for over 5 seconds, and sings. Particularly favoured nest sites are in among the cairns of Mani stones and in the old piled-up clods of earth and turf which compose the walls of the seasonal *mandis* or market places, e.g. at Kharkho, and Gyanima Chhakra. Nest: a cup of mosses and goat hair etc. neatly lined with sheep's wool, ca 3½ in. in diam. Several broods of wobbly-flying, stub-tailed juveniles—3 in each case—fed and fussed over by parents in last week of June and first week of July. When a nest with young was approached the female kept flitting about excitedly, wagging her tail up and down and uttering *Chuck-chrr* presumably in warning to the young. She repeatedly attacked and drove off the male from the proximity when the nest was being searched for, as if apprehensive of his giving away the position.

[Often seen between Mānasarōwar and Gartok. Sept. 1932 F. Ludlow]

**The Eastern Indian Redstart.** *Phoenicurus ochruros* [*rufiventris* (Vieillot) ? ].

Observed at Darchan, Diraphukh, Zūnthūlpūk, Pēfing Yōma, Chhūmersila, Gyanima Chhakra, Shēlēkhookar. Highest 18,000 ft. Pairs. Scattered, but locally numerous. Nesting in stone and boulder littered country at the base of mountains in Lha Chhu Valley and elsewhere in Kailās range. Nests: cups of goat and yak hair—in holes in steep outscoured conglomerate or crumbling earth banks in side valleys opening on Barkha Plain. Found many nests with eggs or young—mostly 3. Wobbly, stub-tailed juveniles about in first week of July. One nest on ground among exposed roots of furze bush overhanging steep eroded earth bank of stream. Two nests at Zūnthūlpūk within 10 yards of each other watched for over an hour and a curious state of affairs noted. Both nests contained young but in one only a female was feeding, in the other only a male. Although these nests were in such close proximity and the birds frequently within a few feet of each other outside the nest—sometimes with food in bill, sometimes without—there was no rivalry of any sort observed. May it be that both the nests belonged to one and the same pair and that the male had taken over incubation in the first nest while the female laid again in the second? I cannot think of another explanation.

The race here is evidently *rufiventris* with practically no grey fringes to the black feathers of the upper parts. However, a specimen obtained by Ludlow at Rakhas Tāl, Sept. 1932, is identified as *P.d. phoenicuroides*. *Phoenicurus erythrogaster grandis* (Gould). Guldenstadt's Redstart.

'Common on the Kailās circuit between 16,000 and 18,000 ft.' September 1932. F. Ludlow.

**The Rubythroat.** *Calliope pectoralis*

Observed at Sēkang, Ngāyēzē, Shēlēkhookar, Māpcha Chhūngo, Rōnām. Nowhere in the Kailās circuit or north of the Barkha Plain.

Commonly nesting in furze bushes in the environs of lakes, streams and 'tundra' bogs. Numerous globular or dome-shaped nests of grass with lateral entrance, low down within furze hedgehogs, with eggs or newly hatched young (normally 3), in first half of June. Wobbly stub-tailed juveniles in 1st week of July. Eggs very handsome bluish-green or deep sea-green. Both sexes feed

the young. All the birds I met were very shy and circumspect when approaching nest with eggs or young. The male sings constantly from the top of a furze bush in the proximity of the nest. The song is very similar to that of the Pied Bush-chat, and of 3 or 4 seconds' duration. It is repeated almost without a break—to the point of monotony—for half to one hour at a time. The singing stance is also as in that bird: tail loosely depressed, wings partly drooping at the sides. In one instance the singing day commenced at 04.10 and ended 20.30 hours, when the condition of the light was about the same as at start—almost dark. While singing, the brilliant ruby throat-patch scintillates catching the light at different angles in a remarkable way.

My notes make no mention of the white moustachial streak that distinguishes the Tibetan species *tschebaiewi*. I hardly think that such a prominent feature if present could have been overlooked, especially with binoculars and at close range. Therefore I feel that the birds I met were not *tschebaiewi* although this is the form recorded from Ladakh and the Gyantse neighbourhood. It is unfortunate that no specimens could be secured. A ♂ and ♀ obtained by Ludlow at Menga (14,300 ft.) further west, on Sept. 16, 1932 were identified as *tschebaiewi*.

#### The Blue Rock Thrush. *Monticola solitaria*.

Observed at Taklākōt, Toyo, Gemoshisa.

Uncommon. Only 3 or 4 solos and 2 or 3 pairs sporadically during entire trek. One carrying food for young to rocky hillside, 30-6-45. The song of the male is rather like the Rubythroat's but longer and richer—with more of the thrush quality. In the breeding season it has a habit of singing as it volplanes gracefully along the contours of a cliff, very like a child's paper aeroplane.

#### The Robin Hedge-Sparrow. *Prunella rubeculoides*.

Observed at Lipu Lekh Pass, Sêkang, Rangūng, Tarchan, Diraphūk, Zūnthūlpūk. Highest 17,000 ft. Pairs in and about furze patches in the neighbourhood of snow-fed streams and tundra bogs. Tame and confiding. Hops about on ground like House-Sparrow, picking up food. Call: a feeble *Tūllili*.

Breeding general in first half of June. Nest: a grass-lined hollow on the mound forming the core of a furze 'hedgehog', well concealed within the bush. This appeared to be the most usual site. One nest was placed in a hollow in the bank of a partially frozen stream. C/3 was the norm, the eggs being of the typical hedgesparrow blue, unmarked and very handsome.

#### The Garhwal Hedge-Sparrow. *Laiscopus collaris whymperi*. Stuart Baker.

Specimens obtained on Lipu Lekh by F. Ludlow, 2 Sept. 1932.

#### Tickell's Willow-Warbler. *Phylloscopus affinis* (Tickell).

Observed at Sêkang, Ngāyēzē, Tarchan, Zūnthūlpūk, Pēlung Yōma, Shēlēkhōokar, Māpcha Chhūngo, Rōnām. Highest 16,000 ft.

Abundant in dense furze facies especially on gentle lower slopes of hills flanking stream valleys, e.g. Harkang 'lūmbo' and Māpcha Chhūngo. In pairs, and breeding freely everywhere throughout June and first week of July (after which I left Tibet.).

Males sing constantly from bush tops: a loud *Pick—pick* (or only a single *pick*) *whiu-whiu-whiu-whiu*. Nest a ball of grass ca 6 in. x 4 in. with lateral opening near top, lined with soft feathers. Placed up to 2 ft. up in a furze bush. Norm c/4. Eggs of 2 types: (1) Pure immaculate white, (2) white sparsely stippled with rust-red especially at broad end. Average measurements of 6 eggs 16x12.5 mm. Numerous nests contained eggs in second week of June, and newly hatched chicks in first week of July. During the latter period also many wobbly juveniles were on the wing.

Both parents feed the young, and are circumspect when approaching the nest. In one case feeding continued till 20.30 hrs.—when almost dark.

[Obtained on the Lipu Lekh at 12,500 ft. and noted at Darchan F. Ludlow Sept. 1932.]

**The Rosy Pastor.** *Pastor roseus* Linn.

A solitary straggler—adult in perfect summer dress—was observed among grazing ponies on lush grassland in the Karnali river valley, between Toyo village and Taklākōt, 6-7-1945. This was the only example met with during the entire trip.

**The Great Rose-Finch.** *Carpodacus rubicilla*.

Observed at Pāla (ca 14,000 ft.) near Lipu Lekh Pass.

Quite common. Singly or in pairs on stone littered open ground.

[Ludlow obtained a specimen of *severtzovi* on Lipu Lekh and noted it as common at Taklākōt and Darchan. Sept. 1932]

**The Red-breasted Rose-Finch.** *Pyrrospiza punicea*.

Observed at Tarchan, Lejandak, Pāla. Highest ca 15,500 ft.

Occasional pairs on bare rugged hillsides. Not common.

**The Pink-browed Rose-Finch.** *Propasser rhodochrous*.

Observed only at Pāla, ca 14,000 ft.—A flock.

**The Goldfinch.** *Carduelis caniceps*.

Observed only on the return journey from Gyānima, 6 to 8 July, between Harkang (13,500 ft.) and Taklākōt (13,000 ft.). In pairs, and fairly common. The period of its appearance and its varying local abundance seemed to be closely correlated with the sprouting after winter and varying local flowering of the Thistle on the seeds of which it was constantly feeding.

Ludlow observed Goldfinches at Taklākōt in Sept. 1932, but took no specimens.

**The Twite.** *Acanthis flavirostris*.

Observed at Sekang, Chhūmersila, Shālēkhookar, Rōnām. Highest ca 15,000 ft.

In parties of 6 to 8 on screes and stony hillsides. Between 13 and 14 thousand feet appeared to be its optimum zone. Easily distinguished from other similar finches by its slender build and bill, pale pink rump (especially in the male), distinctly forked tail, and the *twite-twite* uttered in flight.

Ludlow found the race *ladacensis* common about Taklākōt in Sept. 1932.

**The Gold-fronted Finch.** *Metaponia pusilla*.

Observed only at Taklākōt both when I passed through in the first week of June and on my return visit in the 1st week of July. Parties in June, pairs in July, on open shingle screes. Utters a feeble but sharp *tree-tree* and also a musical *chiririri*.

[Noted at Taklākōt, Sept. 1932. F. Ludlow.]

**The House-Sparrow.** *Passer domesticus*.

Observed only at Taklākōt (13,000 ft.) and Toyo village, which might be called its suburb. None in the gompas or monasteries in the Mānasarōwar-Kailās circuit.

A number are said to spend the winter in the Taklākōt monastery situated on a hilltop about 500 ft. above the *mandi*. In early June while the *mandi* was still largely deserted I found fair numbers of sparrows occupying holes in the thatching of the monastery buildings. In July when the *mandi* was more or less tenanted by traders, sparrows were in much greater abundance here. Some of the birds had doubtless come down from the monastery, but the large numbers suggested that others had immigrated from elsewhere. They were nesting freely in the shop buildings in early July. Also noted in Sept. 1932 by Ludlow. Race *parkini* (= *bactrianus*.)

**The Tree Sparrow.** *Passer montanus*.

One very doubtful and unconfirmed sight record from the monastery at Tarchan (15,500 ft.) on a stony treeless hillside!

**The (Tibetan) Mountain Finch.** *Fringillauda brandii haematopygia* (Gould).

Observed at Ngāyēzē, Diraphūk, Chhūmersila, Gyānima Mandi, Pāla. Highest ca 17,000 ft. Frequent flocks on scree fans and stony hillsides all along the Kailās *parikrama*. Large numbers at water's edge on the S-W shore of Mānasarowar lake and on adjacent bogs, hopping or running about—looking very like stints in the distance—picking up seeds (presumably) washed up by the ripples. Sometimes only one or two individuals, at others dense flocks of 50 or more. No sign of breeding activity noted up to 2nd. week of July. Ludlow collected specimens on the Lipu Lekh and at Rākhas Tāl, and observed it on the Kailās circuit. Sept. 1932.

**Stoliczka's Mountain Finch.** *Fringillauda nemoricola* [altaica (Eversm.)]

Observed only at Pāla (ca 14,000 ft.—near Lipu Lekh Pass). Fairly common. Small parties on bare stony hillsides and scree fans.

An ad. and juv. were collected by Ludlow on the Lipu Lekh in Sept. 1932.

**The Tibet Snow-Finch.** *Montifringilla nivalis adamsi* Adams.

Observed at Pāla, Taklākōt, Ngāyēzē, Nyandi, Diraphūk and all along the Kailās circuit; Māpcha Chhūngō. Highest 17,000 ft.

Fairly common. Pairs, on open scree fans, stony ground about base of hills and snow patches. Breeding in June and July. Many entering or leaving holes in clay cliffs or burrows of voles and mouse-hares. Commonly seen flying with beakfuls of insects collected mostly at edge of water.

Ludlow obtained specimens—1 ad., 1 juv.—near Taklākōt. Sept. 1932.

**The Red-necked Snow-Finch.** *Montifringilla ruficollis* Blanford.

Observed at Kyāngma (Barkha Plain), Lejandak, Gyānima Mandi—all at ca 15,000 ft. Fairly common locally. In pairs on open gravel plain. Nesting in numbers in burrows of mouse-hares (*Ochotona*). Many part-fledged non-flying young sitting about outside burrows on hole-riddled ground, being fed by parents, in the last week of June. Other adults still collecting feathers for nest-lining at end of June. The birds apparently live on terms of amicable 'Co-prosperity' with the rats. A juvenile male caught outside a rat hole with rectrices and remiges in quill, had pale rose-pink undertail coverts. Iris grey-brown, bill ivory yellow, legs and feet slaty black.

**Blanford's Snow-Finch.** *Montifringilla blanfordi* Hume.

Observed at Ding Tso (N.E. of Mānasarowar) ca 15,000'.

Frequent. In pairs and evidently breeding. Seen by F. Ludlow at Barkha, 8 Sept. 1932.

**The House Martin.** *Martula dasypus*.

Observed at Rōnām and Toyo, ca 13,500 ft. A few hawking in Harkang 'lūmbo' (river valley) and over Karnāli river near Toyo village, 5 & 6 July. Not met with anywhere in June.

Ludlow also saw it at Taklākōt in Sept. 1932, but did not collect specimens.

**Sand Martin.** *Riparia riparia*.

Observed at Jiu Gompa, Barkha, Lejandak—all ca 15,000 ft.

Uncommon. Sporadic pairs near streams or small pools flanked by earth banks where presumably nesting. White or almost white on lower abdomen. Identity uncertain.

**The Crag Martin.** *Riparia rupestris* (Scop.).

Observed at Lejandak (S edge of Barkha Plain) ca 15,000 ft. and Toyo (near Taklākōt) 13,000. Uncommon. Pairs about cliffs flanking streams. On 6 July a pair were collecting mud at the edge of Karnāli River near Toyo and building about a hundred feet up on a rock face.

Taklākōt, Sept. 1932. F. Ludlow!

**Hodgson's Pied Wagtail.** *Motacilla alba alboides* Hodgs.

Observed only at Talākot (13,000 ft.). Ludlow collected a specimen near Zorāwar Singh's tomb at Rugong in Sept. 1939. 'Apparently the breeding bird on the plateau.' A pair, both with grey backs instead of black, was also observed a month later in the same locality on the Karnāli River and put down in my notes as *M.a. personata*. This, however, must be accepted with reserve in view of Meinertzhagen's categorical statement in the Ibis (1927) that Osmaston's record of *personata* in Ladakh must 'without doubt' refer to *alboides*. Osmaston's list (from sight) omits *alboides*, and Meinertzhagen who collected specimens never came across *personata* there!

Ludlow obtained a specimen of *personata* at Gartok, farther west in this area, on 24 Sept. 1932, presumably a migrant according to him.

**The Yellow-headed Wagtail.** *Motacilla citreola*.

Observed at Sēkang, Ngāyēzē, Gyānima Chhakra, Rōnām. Highest ca 15,300 ft.

Not common, but pairs frequent on water meadows and bogland. Males yellow-headed, black-backed; females grey-backed, with yellow forehead and supercilium. Evidently breeding.

***Anthus* sp: Pipit.**

Ludlow obtained a specimen on the shores of Rākhas Lake on 6 September 1932, regarding which Whistler remarks 'I do not feel quite happy about this bird—it seems to be either *campestris* or *thermophilus*, and I should have said the latter only the hind claws are so short'. Ludlow had put this down in his field note book as *Anthus richardi*. He obtained specimens of this same pipit in Sept. and Oct. 1933 on the Phari-Gyantse road (Ibis 1937, p. 481) and also in S.E. Tibet in the autumn of 1936 and 1938 (Ibis 1944, p. 363). All these birds were fat and appeared to be on migration.

**Elwes's Horned Lark.** *Eremophila alpestris elwesi* (Blanford).

Observed everywhere except at Diraphūk (N. of Kailās).

Without doubt the most characteristic and abundant bird species on the bare, stony plateau at about 15,000 ft. altitude. In pairs, and breeding plentifully in June. Numerous nests with eggs or young seen, normally c/2 or c/3.

The eggs are brownish pale grey or greyish-stone colour, heavily but finely splashed all over with brown, more densely at the broad end. They measure 24-26 mm. × 17-18 mm. The hatchlings are covered with sparse yellowish-white down.

The nest is a round cup-like depression anywhere on the open featureless plain, neatly lined with soft grass and sheep's wool, measuring about 3 in. across by 1.5 to 1.75 in. deep.

The male has a feeble squeaky song of disjointed strophes, usually uttered from a stone, rather of the volume and quality of some Willow-Warbler's song. Both parents feed the young and attend to the nest sanitation, but what part if any the male takes in incubation I was unable to determine.

**The Long-billed Calandra Lark.** *Melanocorypha maxima* Blyth.

Observed at Sēkang, Ngāyēzē, Ding Tso, Gyānima Tso—all ca 15,000 ft. Fairly common and abundant on tundra bogs on the edge of lakes and snow-fed streams. Breeding was in progress during June. Birds carrying nest material or constantly chasing one another around were noted at Mānasarōwar. When pursuing a rival the bird flies low with a slow, deliberate flapping of its wings. When alighting after the intruder has been driven off the wings are held motionless in a wide V above the back and the tail spread out exhibiting the white outer feathers prominently. The song, usually uttered from a 'hump' in a bog, is a series of broken or disjointed strophes in which imitations of the calls of other birds, e.g. the *tee-tee-tee* of the Redshank and the *tee-tee-tee* of the going-away Green Sandpiper are skilfully interlarded. In the latter case it would be interesting to know where the bird picked up the notes, since the

Green Sandpiper does not occur in these parts.<sup>1</sup> While singing the wings are drooped and excitedly twitched open and closed, the tail partially cocked and the bird turns lightly from side to side. Occasionally a few bars are also sung on the wing.

The nest is a cup-like depression on a water-girt or partially spongy 'hump' in a bog, lined with green grass. The eggs—normally 3—are olive-cream in colour densely blotched with brown almost concealing the ground colour. Two measured  $28 \times 20$  and  $28 \times 21$  mm. One nest (on 27 June) contained 3 chicks about 8 days old partly in down and partly buff-tipped black feathers, with wings and tail in quill. Gape yellow. Inside mouth bright reddish-orange, with 3 black tongue-spots, one at apex and one each on either side of it. Mouth very conspicuous when chicks lying doggo with bill open. Warning pattern?

**The Tibetan Skylark.** *Aldaia gulula lhamarum* Meinertzh.

Observed at Taklākōt and environs, including Toyo—between 13,000 and 13,500 ft. local. Fairly plentiful in the barley and gram cultivation around villages. Soaring, singing and chasing rivals during June. Frequently a dozen or more up in the air and singing simultaneously. On completion of the song it descends steeply in spirals or in 'falling leaf' style, wings motionless and often held in a wide V above the back in a manner reminiscent of our Red-winged Bush Lark (*Mirafra erythroptera*). Many birds were feeding young in the first week of July.

Ludlow found it common near Taklākōt in Sept. 1932 and obtained a specimen at Rugong.

**The Rufous Short-toed Lark.** *Calandrella brachydactyla dukhunensis*.

Ludlow obtained specimens at Rākhas Tāl in Sept. 1932, and found it abundant between Rākhas Tāl and Gartok, in flocks.

**The Short-toed Lark.** *Calandrella acutirostris*.

Observed throughout except about Diraphūk (N or Kailās). The second commonest and most abundant bird species in this part of Tibet. It loves open stony and shingly wastes and was most plentiful, in pairs, on the Barkha Plain where breeding was in full swing during June. Although its nests on the same sort of gravelly flat ground as the Horned Lark, I noted the nests to be as a rule less distant from water than in that species. The adults resort regularly to bogs and the water's edge e.g. at Mānasarōwar, Ding Tso, Gyānima Tso, to collect insects for their young.

Its usual note is a sharp *trri*. The male occasionally soars wanders and sings an insipid song consisting for the most part of its own *trri* notes strung out disjointedly. The nest is very similar to that of the Horned Lark but smaller, measuring about 2.5 in. in diameter  $\times$  1.25 in. to 1.75 in. deep. Sometimes it is quite unprotected and in the open, at others under a diminutive bush. c/3 is the norm. The eggs are greyish-white faintly stippled or splashed with pale brown somewhat more densely at the broad end where the markings sometimes coalesce to form a distinct ring. Several measured were  $22-23 \times 15-16$  mm. Many birds were feeding young in the first week of July.

Ludlow obtained specimens at Rugong, and found it common everywhere in September 1932.

**The Hoopoe.** *Upupa epops* subsp.

I did not come across it at all in June-July, but in September Ludlow found it common everywhere from the Lipu Lekh to Darchan, on the Kailās circuit and elsewhere in Western Tibet.

**The Swift.** *Micropus apus*.

Observed only at Toyo, 13,000 ft., 6-7-45: Several birds hawking about the conglomerate cliffs flanking the Karnālī River.

<sup>1</sup> Ludlow records it in his notes.

**The Horned Owl.** *Bubo bubo*.

Observed only near Jiu Gompa ca 15,000 ft. (N. of Mānasarōwar). A solo sleeping in an outscoured hollow in a steep clay bank of the Ganga Chhu near the hot springs, 16-6-45.

**The Little Owl.** *Athene noctua* subsp.

Ludlow saw a little owlet, 'probably ludlowi' at Darchan in September 1932.

**The Himalayan Griffon Vulture.** *Gyps himalayensis* Hume.

Observed only at Nyandi Gompa ca 16,000 ft., (W. of Kailās) a solo soaring high above the monastery, 19-6-45.

**The Lämmergeier or Bearded Vulture.** *Gypaëtus barbatus*.

Observed at Taklāköt, Tarchan, Diraphük.

Uncommon. Occasional solos sailing round contours of cliffs etc.

'Seen between Lipu Lekh and Darchan' F. Ludlow, Sept. 1932.

**The Kest rel.** *Falco tinnunculus*.

Observed at Ngāyēzē, Gossul Gompa (W. shore of Mānasarōwar), Ding Tso, Gyānima Mandi. Sporadic solos.

**The Cherrug Falcon.** ? *Falco cherrug*.

Observed at Lējandak, ca 15,000 ft. (S. edge of Barkha Plain). A solo on the wing at long range, 27-6-45. Identity not verified.

**Eagle.** *Aquila rapax*.

Observed only at Khārkho, ca 15,000 ft., 2-7-45.

A solo in tundra bog by Gyānima Tso, chivvied and chased about by a pair of Brahminy Duck. General colouration blackish. Cere grey. No pale bar in tail.

**The Tawny Eagle.** *Aquila rapax*.

Observed only near Jiu Gompa ca 15,000 ft (N. shore of Mānasarōwar) 16-6-45. Solo. Identity doubtful.

**Pallas's Fishing Eagle.** *Haliaëtus leucoryphus* (Fall.).

Observed at Ngāyēzē, Gossul Gompa, Zūnthūlpük, Ding Tso, Lha Chhu, Gyānima Tso, Rākhas Tāl. Highest 16,000 ft. Quite common and plentiful in the neighbourhood of the lakes. Usually seen singly perched inert on mounds around or in the midst of the adjacent marshes. At the N.E. end of Ding Tso over 20 birds were counted on an area of perhaps as many acres, and 15 on another small tundra bog along the southern edge of Nāl Ugro (the name of the northern section of Barkha Plain which extends eastward to Ding Tso). They all seemed to be well gorged most of the time. Except for a single instance I never saw any of the birds making the least effort to obtain food. On that occasion a bird caught a fish about 12 in. long.

This eagle is doubtless only a summer visitor to these high elevation lakes. There are no trees here for it to nest in, and during winter food must be unobtainable since all the waters become frozen.

Ludlow only saw a single pair on the Ganga Chhu at Jiu on 7th Sept. (1932) which suggests that southward emigration may already have begun.

**The Buzzard.** *Buteo* sp.?

Observed on Barkha Plain below Tarchan, ca 15,000 ft.

A pair on ground by shepherds' encampment. General colouration chestnut. Head and neck pale—almost buffy cream. Tail buffy cream colour, as also a large round patch near tip of open wings, on the underside.





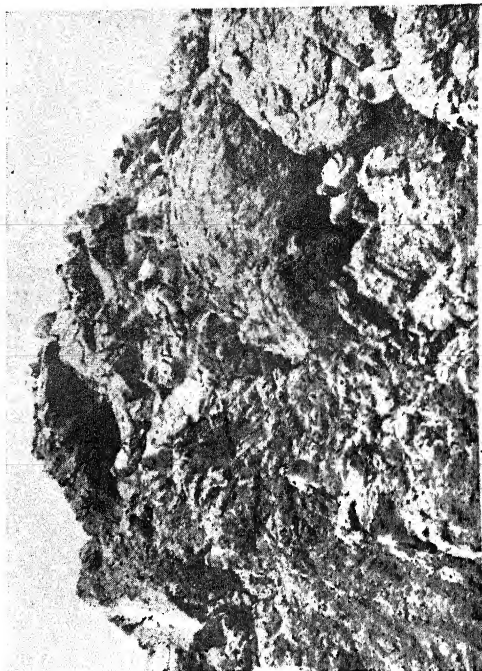
Nest and chicks of Large Calandra Lark



Tibetan Sandgrouse and chicks

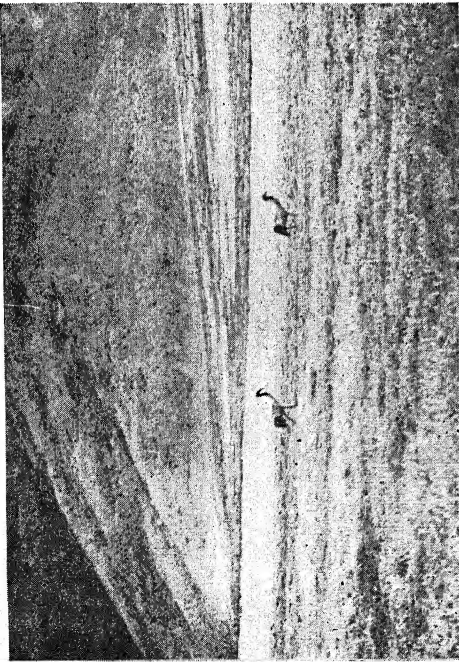


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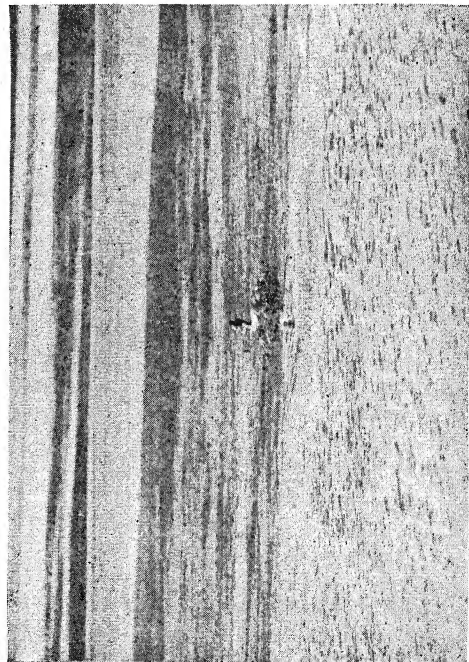


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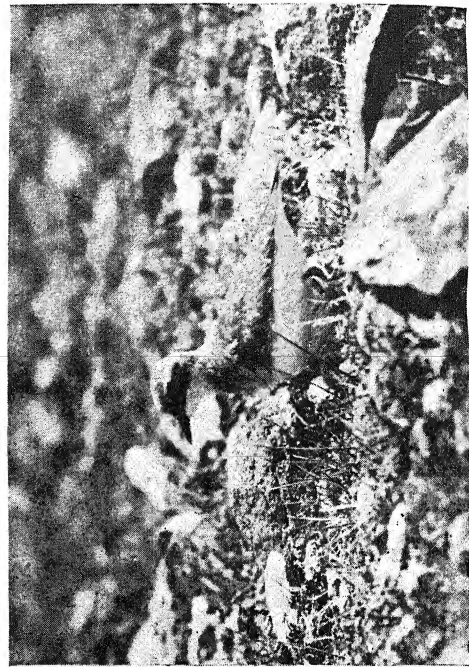
Black-necked Cranes on nesting ground



Eared Grebe on nest



Nest and Eggs of Redshank



Pamirs Lesser Sand Plover at nest

**The Turkestan Hill Pigeon.** *Columba rupestris turkestanica* Buturlin.

Observed at Taklaköt, Toyo, Ngäyêzê, Gossul Gompa (W. shore of Mānasarōwar), Diraphük, Dölma La, Gyānima Mandi, Pāla. Highest 18,600 ft.

Common locally about villages, cultivation and monasteries. Living in colonies on cliffs. Numbers were usually met with at all goat-train halting stations, feeding on the grain dropped out of the pannier packs. Also at the summit of well-used mountain passes where grain is springled in thanksgiving by pious pilgrims. Its call is a high-pitched 'cheeky' quick-repeated *Gūt-gūt-gūt-gūt*, reminiscent of Jerdon's Imperial Pigeon (*Ducula b. cuprea*) of Southern India.

This pigeon, easily distinguished from our familiar Blue Rock (*C. livia*) by its whitish underparts and the broad white bar across its tail, completely replaces *livia* trans-Himalaya.

Ludlow noted it as common at Taklaköt, and between Tarchan and Gartok. Sept. 1932.

**The Snow Pigeon.** *Columba leuconota*.

Only observed at Pāla ca 14,200 ft. (near Lipu Pass) 8-7-45—a pair.

This species was otherwise completely absent trans-Himalaya. Ludlow did not meet with it in Sept. (1932).

**The Tibetan Sandgrouse.** *Syrhaptes tibetanus* Gould.

Observed at Rangūng, Sēkang, Gemoshisa. Highest ca 15,000 ft.

Not uncommon. In pairs or parties of 6 to 15 on bare gravelly plains and drinking at tundra-girt streams etc. Surprisingly tame, allowing approach within easy catapult range. Call: typical Sandgrouse but deeper and more musical—a pleasant loud *koonk-koonk* etc. in slightly varying keys, reminiscent of the Demoiselle Crane (*Anthropoides virgo*). Usually uttered on the wing. Ludlow found them in flocks of 20-30 and very tame, between Rākhas Tāl and Gartok—Sept. 1932. On 1 July a flock was come upon including a pair with 3 (or 4?) juveniles in mixed down and feather plumage, about the size of Grey Quail. Swift runners. When approached, the parents and young isolated themselves and walked away from the rest of the flock. After submitting to encirclement by 3 people for over 5 minutes for photographs, the female suddenly apprehended danger and commenced doing the 'broken wing' trick, fluttering piteously along the ground for over 20 yards away from the chicks. Upon this the chicks immediately lay doggo and 'froze', becoming completely obliterated from view among the gravel though only a few feet away. They would have been quite easily lost if only one pair of eyes had been watching and that momentarily distracted by the adult's antics.

**The Chakor.** *Alectoris graeca chukar*.

Ludlow obtained specimens near Taklaköt in the first week of September (1932).

**The Snow Cock.** *Tetraogallus* sp?

Heard in the Kailās Range near Diraphük at ca 17,000 ft. (19-6-45) and on the rugged crags above Shēlēkhookar ca 16,000 ft. (4-7-45).

4 birds shot by Ludlow in the Sazi La, farther to the west, in Sept. (1932) are *T. t. tibetanus*.

**The Black-necked Crane.** *Grus nigricollis* Przewalski.

Observed at Ding Tso, Lejandak Tso, Gyānima Tso (Khārkho)—all ca 15,000 ft. Frequent tundra bogs around the margin of lakes. In pairs during June and early July, and breeding. Pairs prancing and leaping widely and bowing to each other exactly as in the Sarus Crane. Voice and trumpeting calls also very similar to that bird's, only somewhat higher pitched.

A nest consisting of a few reeds spread out, with a single fresh egg, was found on 25 June on a spongy grass-covered hump—floating islet—in the broad belt of bog on the N. edge of Ding Tso lake. The egg is greenish-grey or olive-grey in colour with rough splotches of faint reddish-brown all over, more densely

at the broad end. It measures 107×66 mm. Its contents, equal to about 6 fowl's eggs, were delicious scrambled and provided a welcome change from the eternal dal and rice!

**The Brown-headed Gull.** *Larus brunnicephalus* Jerdon.

Observed at Ngāyēzē, Tseti Tso (W. shore of Manasarōwar), Ganga Chhu (near Jin Gompa), Barkha, Ding Tso, Lha Chhu, Gyānima Tso (Khārko)—all between 15,000 and 15,900 ft.

Fairly common and in full brown-headed summer plumage. About 50 pairs nesting in an inaccessible part of bog along the eastern shore of Ding Tso Lake, 25-6-45. Each nest was a separate raised mound of grass etc. above water level and a few feet away from its neighbour. Now mostly with eggs. Several pairs were also nesting in a similar marsh about Gyānima Tso, 2 July.

On Tseti Tso I noted a single example of a smaller gull without brown head which looked exceedingly like the Black-headed (*L. ridibundus*) and had the colour pattern of that species in the wing.

Seen on Rākhas Tāl in Sept. (1932) by Ludlow.

**The Tibetan Tern.** *Sterna hirundo tibetana* Saunders.

Observed at Rangūng, Ngāyēzē, Tseti Tso, Barkha, Ding Tso, Gyānima Tso (Khārko), Taklākōt.

In small numbers at all waters and marshes on the plateau, beating up and down and occasionally plunging in for food. Pairs chivvying Black-necked Cranes and a man approaching a particular islet in Ding Tso, 25-6-45. Undoubtedly breeding, but no nest discovered. Its call is a harsh *kreeak* or *SEAC* very like the croak of the Tibetan Raven.

Manasarōwar and Rākhas Tāl in Sept. 1 F. Ludlow.

**The Oystercatcher.** *Haematopus ostralegus*.

'I saw, to my surprise, an Oystercatcher at Rugong on 6 September' (1932) F. Ludlow.

**The Pamirs Lesser Sand-Plover.** *Charadrius mongolus (atrifrons* Wagler).

Observed at Sēkang, Ngāyēzē, Tseti Tso, Ganga Chhu (near Jiu Gompa), Barkha, Pēlūng Yōma, Ding Tso, Gyānima Tso (Khārko and Chhakra), Shēlēkhōokar—all between 14,500 and 15,500 ft. Common. Pairs on and about tundra bogs everywhere. Now in handsome breeding plumage with rust coloured breast, hind head and upper neck—very different from the prosaic sandy brown garb in which we see it on the western seaboard in winter. Territorial rivalry and pre-nuptial chasing in progress. In this the birds fly close above the ground on rapidly vibrating wings, uttering a peculiar hard *Tk-tatrr-tatrrwhee*. Sometimes the 'war cry' is *Tit-tit-trr-trrweeet* of the same quality as the call of the Indian Nightjar (*Caprimulgus asiaticus*).

Several nests with c/3 found in June on dry stony ground beyond the fringe of marshes. The nest is merely an unlined scrape. Eggs pale green to dark biscuit colour or khaki, stippled fairly evenly all over with reddish-brown (dry blood colour). The 'broken wing' trick appears to be very popular with this species.

Observed on the southern shores of Rākhas Tāl, 6 Sept. (1932) by Ludlow.

**The Curlew.** *Numenius arquata* subsp.

'Seen near Rugong on 6 September' (1932) F. Ludlow.

**The Green Sandpiper.** *Tringa ochropus*.

Jiu, 7 Sept. 1932! F. Ludlow.

**The Redshank.** *Tringa totanus*.

Observed at Ding Tso, Gyānima Tso (Khārko)—ca 15,000 ft.

15 to 20 pairs on the former and at least 2 pairs on the latter; all evidently breeding on the tundra bog along the margins of the lakes. A nest (25 June) was a deepish scrape lined with grass on a flat grassy islet in Ding Tso, and

contained c/4. The eggs were drab-coloured with purplish-brown markings. They were surprisingly large for the size of the bird, being bigger than those of the Red-wattled Lapwing.

**Temminck's Stint.** *Erolia temminckii*.

Ludlow obtained a specimen at Rugong, 5 September (1932).

**The Bar-headed Goose.** *Anser indicus* Latham.

Observed at Taklākōt, Ngāyēzē, Tseti Tso, Ding Tso, Lha Chhu, Gyānima Tso (Khārkho)—13 to 15,000 ft.

Common, in fair numbers, at all lakes, large and small, frequenting the pools and shallows in and about the tundra bogs around their margins. Nesting was general in June, and several pairs leading downy goslings. Breeding evidently commences early as by 30 June many full-fledged young of the year were already about in family parties. The nests are pads of down and feathers individually or several together a few yards apart, in a depression on the spongy semi-floating 'humps', usually in an inaccessible part of a marsh. The normal clutch was of 3 to 5, the eggs being ivory white in colour and thick-shelled. Two measured  $81 \times 57$ ,  $87 \times 57$  mm.

The Bar-head was reported by the locals to breed regularly in very large numbers on the islets known as Lachato and Topserma in the S. and W. of Rākhas Tāl, but without a boat it was impossible for me to visit these places. In contrast to their well-known wariness in their winter quarters, the birds were amazingly tame and confiding here. At Tseti Tso 10 to 15 pairs with perhaps as many Brahminy Ducks grazed unconcernedly on the grassy margin of the lake at sunset within 50 yards of our tents! The local Tibetans have a legend that the geese, having gorged themselves on rice during the winter months in the plains, have lost their voice (some say even sight) when they first arrive here in spring. Only after eating the salt in the vicinity of the sacred lake do they regain these senses and resume their normal 'aang-aang' calls. They say that the birds come flying in so thickly wing to wing, that if one of their number is shot dead he is borne along on the wings of his companions. The fatality is only discovered when the birds are alighting on Mānasarōwar!

Rākhas Tāl, Jiu and Barkha! Sept. 1932. F. Ludlow.

**The Gadwall.** *Anas acuta* Linn.

**The Pintail.** *Anas strepera* Linn.

Observed only at Ngāyēzē, 13-6-45. Several among a mixed flock of about 50 duck keeping to a lagoon and mudspit on the S.W. shore of Mānasarōwar. Apparently not interested in breeding here.

**The Brahminy Duck.** *Casarca ferruginea* (Vroeg).

Observed at Sēkang, Ngāyēzē, Tseti Tso, Ganga Chhu (near Jiu Gompa), Lha Chhu (near Dirapūkh and on Barkha Plain), Ding Tso, Lejandak Tso and 'lūmbo' (stream valley), Gemoshisa, Gyānima Tso (Khārkho), Shelekhookar—15-17,000 ft.

Common at all lakes. Also in flat boggy stream valleys flanked by high cliffs. Breeding in full swing during June, and many pairs leading downy young. Many breeding high up in holes in precipitous crags, in one case at least 1,500 ft. above the level of the marshy valley bottom. How the fluffy hatchlings would be brought down to the water from this great height remained an intriguing question. It was a curious sight to see these ducks flying along the rugged contours and alighting on rock pinnacles high up on the mountainside—behaving in fact very like rock-pigeons.

On a shingle bank by Mānasarōwar lake a party were observed in some sort of communal (prenuptial?) ceremonies on 13-6-45. Individuals seemed to be chasing individuals on the ground, and pairs pairs. The aggressive attitude was very vulture-like: neck craned forward stiffly bill to ground, wings drooped at sides, and tail spread open and depressed almost scraping the ground. These antics were accompanied by angry notes. They had obviously something to

do with pair formation and approximated to the 'Incitement Displays' described by Heinroth (*Die Vögel mitteleuropas*, Vol. III p. 183)

In September (1932) Ludlow found it common everywhere.

**The Goosander.** *Mergus merganser (orientalis) Gould.*

Observed at Ngāyēzē, Lha Chhu (at Nyandi W. of Mt. Kailās, and on Barkha Plain), Zūnthūlpūkh. Occasional solos or pairs on lakes and streams. No sign of breeding activity.

**The Great Crested Grebe.** *Podiceps cristatus.*

Observed at Ngāyēzē (Mānasarowar), Ding Tso, Gyānima Tso (Khārkhō).

Quite common. Nesting plentifully in June. Eggs. On a lagoon (S.W. shore of Mānasarōwar) counted 8 nests with birds brooding in an area of less than 10 acres; 40 to 50 nests in another smaller area on the E. shore of Ding Tso adjoining the breeding colony of Brown-headed Gulls. The nest is a collection of grass etc. on a floating or anchored mound of rubbish and weeds. In almost every case the sitting bird covered up the eggs with nest material before swimming away on my approach.

## BIRDS NOTED IN THE MAHASU-NARKANDA-BAGHI AREA OF THE SIMLA HILLS.

BY

N. F. FROME, C.I.E., D.F.C., M.S.C., M.B.O.U.

A trek to Narkanda and Baghi, the latter some 50 miles further into the hills north-east of Simla, is nowadays quite popular with visitors to the Simla hills. Having had the opportunity during two successive years of making this enjoyable trip during the first fortnight of June, when on each journey detailed records of the birds seen were kept, an account of the species noted may be some value to others who visit Narkanda and Baghi just before the rains.

The list given hereafter (which is by no means comprehensive but contains, it is believed, most of the commoner birds to be seen) refers only to the area from Mahasu (8,300 feet) six miles from Simla, to Narkanda (9,100 feet) on the main Hindustan-Tibet road and along the mule track to Baghi (8,850 feet) and Kadrāla (8,900 feet) 10 and 17 miles, respectively, further east of Narkanda. From Mahasu the first stage of 6 miles to Fagu (8,200 feet) is mostly in forest; the second stage of 5 miles to Theog (7,400 feet) traverses open scree covered hillsides and cultivated tracts; coniferous forest, steep hillsides and cultivation occur on the next 11 miles to Mattiana (7,700 feet). At Mattiana which is at the head of a long valley leading to the Giri watershed more 'foothills' species seem to occur than elsewhere on the route. The 11-mile stage from Mattiana to Narkanda contains cliffs, ravines and stretches of denser forest. Between Narkanda and Baghi both the main Hindustan-Tibet road, continuing to Rampūr in the Sutlej valley, and the branch path to Baghi skirt Mount Hathu through heavy pine and spruce forest with immense trees and precipitous hillsides. From Baghi to Kadrāla forest alternates with open hillsides and rocky ravines. As would be expected, therefore, a variety of tree and forest haunting birds as well as those which favour more open and cultivated hill

country may be seen. Of interest is the extent to which nominally 'plains' species such as the House Sparrow, Common Mynah and Common Pariah Kite have penetrated the Simla Hills.

An indication of the commonness of the various species in late May and early June in accordance with the frequency with which observed in the two successive years is included in the notes. Incidentally, throughout the area it was found that the best time to see and hear birds is as elsewhere, from just before sunrise until about 11.0 a.m. and after that time late in the evening.

***Corvus macrorhynchos.*** The Jungle Crow.

Common throughout the whole area in all types of country. Seen up to 10,000 feet. Even in secluded forest tracts, one or two of these birds soon appear to investigate the intruder's food producing possibilities!

***Urocissa melanocephala.*** The Red-billed Blue Magpie.

Fairly common en route and common in the Narkanda and Baghi area where its 'kik-kik-kik kuk-kuk-kuk' call is frequently heard as well as a variety of other metallic alarm notes and calls.

***Urocissa flavirostris.*** The Yellow-billed Blue Magpie.

Uncommon—seen only on two occasions in the Mahasu-Kufri ridge forest.

***Garrulus lanceolatus.*** The Black-throated Jay.

Not common—seen once near Mattiana.

***Garrulus bispecularis.*** The Himalayan Jay.

Grating calls are fairly often heard, but this bird needs to be looked for, when it may be seen in the forests up to Baghi usually slipping from bough to bough of a tree close to the trunk.

***Nucifraga caryocatactes.*** The Himalayan Nutcracker.

Occasionally heard and seen en route; its noisy harsh calls and mewing cries commenting on every happening within its ken are especially evident in the Narkanda, Baghi and Kadrula forests where it is very common.

***Parus monticolus.*** The Green-backed Tit.

Fairly common and occurs at Narkanda, Baghi and Kadrula. Call;—'teacher'—frequently heard.

***Lophophanes melanophus.*** The Crested Black Tit.

Common in forests everywhere—in early June usually to be seen collecting food for young.

***Lophophanes rufonuchalis.*** The Simla Black Tit.

Fairly common in the Baghi forests—a larger and darker edition of the Crested Black Tit.

***Lophophanes dichrous.*** The Brown Crested Tit.

Noted only in the Narkanda-Baghi forest and at Kadrula. It appears to be uncommon.

***Aegithaliscus concinnus.*** The Red-headed Tit.

Not particularly common but noted at Mahasu, Theog, Mattiana and Baghi in the usual cheeping little parties.

***Sitta himalayensis.*** The White-tailed Nuthatch.

Fairly common in the forest around Mahasu—not observed elsewhere.

***Carrulax albogularis*.** The White-throated Laughing Thrush.

Not very common. Seen on Charabra hill near Mahasu.

***Trochalopteron erythrocephalum*.** The Red-headed Laughing Thrush.

Noted only on the Mahasu-Kufri ridge. A confirmed skulker.

***Trochalopteron variegatum*.** The Variegated Laughing Thrush.

Common especially around Mahasu, Narkanda and Baghi. This bird also has the habit of ascending trees from bough to bough making itself evident with its loud whistle 'pitt-wee-who-eer'.

***Trochalopteron lineatum*.** The Streaked Laughing Thrush.

Common. Occurs in low scrub jungle throughout the whole area—seen up to 9,500 feet. Whistles 'pit-weer' as well as having other squeaking and murmuring notes.

***Grammatoptila striata*.** The Striated Laughing Thrush.

Uncommon. A small party seen only on two occasions on the Mahasu-Kufri ridge. Harsh alarm note 'oick oick oick oick . . .' and a whistling call which may be expressed 'oh see saw oh whitey—oh white'.

***Leioptila capistrata*.** The Black-headed Sibia.

Fairly common in forest everywhere where its loud ringing whistle 'ti-rec-rec ti-rec-rec' is frequently heard. Occurs at Baghi.

***Pteruthius erythropterus*.** The Red-winged Shrike Babbler.

Uncommon. Seen on one or two occasions only in the Mahasu area.

***Molpastes leucogenys*.** The White-cheeked Bulbul.

Fairly common—seen at Fagu, Theog, Mattiana, Narkanda and Baghi but not in the abundance of the Simla foothills.

***Certhia himalayana*.** The Himalayan Tree-Creeper.

Common in forests up to 10,000 feet. Usually brings itself to notice by its thin piping note.

***Luscinia brunnea*.** The Indian Blue Chat.

Noted at Mahasu and frequently seen and heard in undergrowth in the Baghi forests. Precedes its song of a varying number of loud notes with three or four high pitched squeaky whistles.

***Saxicola torquata*.** The Indian Stonechat.

Common on the open hillsides from Fagu to Narkanda, usually perched on top of a bush or stone.

***Rhodophila ferrea*.** The Dark Grey Bush-Chat.

Common throughout the whole area around cultivation and scrub—the male may often be heard singing his soft little song.

***Enicurus maculatus*.** The Western Spotted Forktail.

A pair of these graceful birds were seen on a stream near the Mattiana dak bungalow.

***Turdus albocincta*.** The White-collared Blackbird.

Fairly common in the Narkanda-Baghi forests. Shy.

***Turdus boulboul*.** The Grey-winged Blackbird.

Common around Mahasu but not observed elsewhere en route.



***Arceuthornis viscivorus*.** The Himalayan Missel Thrush.

Fairly common in pairs in the Mahasu area, the Narkanda-Rampur road forest and around Baghi—usually seen on the ground when undisturbed. A fine songster. Is notably common at Kadralla.

***Monticola rufiventris*.** The Chestnut-bellied Rock-Thrush.

Common in pairs around Mahasu and seen near Theog—the harsh scolding note and 'piping' of these birds attract attention.

***Monticola cinclorhyncha*.** The Blue-headed Rock-Thrush.

Not very common—noted only at Baghi where it was seen and heard singing from the tree tops in the early morning and late evening.

***Myophonus caeruleus*.** The Himalayan Whistling Thrush.

Seen and heard occasionally in nullahs containing streams—particularly around Mattiana and Baghi.

***Hemichelidon sibirica*.** The Sooty Flycatcher.

Noted on a number of occasions around Mahasu and in the Baghi and Kadralla forests—especially on the road to Kadralla. Usually seen 'flycatching' from a fixed tree perch.

***Muscicapula superciliaris*.** The White-eyebrowed Blue Flycatcher.

Common in woods and forests throughout the whole area where its soft trilling call note can frequently be heard. Is usually seen collecting food for young in June.

***Eumyias thalassina*.** The Verditer Flycatcher.

Common at Mahasu but not so common elsewhere—seen near Mattiana and Theog.

***Lanius schach*.** The Rufous-backed Shrike.

Not common. Seen on one occasion near Mattiana dak bungalow.

***Pericrocotus brevirostris*.** The Short-billed Minivet.

Fairly common throughout the whole area. Usually seen in small parties or pairs in the tree tops, the scarlet of the males being very conspicuous.

***Dicrurus macrocercus*.** The Black Drongo.

Not very common—seen at Mahasu, Theog and Baghi.

***Dicrurus longicaudatus*.** The Indian Grey Drongo.

Noted only at Mahasu, Mattiana and Baghi.

***Phylloscopus trochiloides*.** The Greenish Willow-Warbler.

A very doubtful identification—but two or three pairs which seemed to be of this species were observed near the Mattiana dak bungalow.

***Phylloscopus magnirostris*.** The Large billed Willow-Warbler.

Noted in the wooded ravines on the side of Mount Hathu. Call note: a high pitched whistle;—'eeeeee, eee-eee, eee-eee.'

***Phylloscopus occipitalis*.** The Large Crowned Willow-Warbler.

Abundant everywhere where there are trees, up to 10,000 feet, and probably higher—its whirring song being a conspicuous feature of the Simla hills in June.

**Horornis pallidus.** The Pale Bush-warbler.

This amusing little bird is common around Narkanda and Baghi. It spends its time creeping about the interior of thick bushes and is difficult to see but its constantly uttered thin whistle 'eu-eu-eu-eu-eu' followed by a loud and vehement 'I see you see?' or 'I see you!' cannot be mistaken.

**Acridotheres tristis.** The Common Mynah.

Has found its way into the hills as far as Mattiana where it is particularly common in and around the village but was not seen beyond that place.

**Perissospiza icteroides.** The Black & Yellow Grosbeak.

Common—especially so in the Mahasu, Narkanda, Baghi and Kadralla forests where its quick whistle 'keeky-too, keeky-too' can constantly be heard. Often seen feeding on the ground.

**Pyrrhula erythrocephala** The Red-headed Bullfinch.

A pair of these handsome finches were seen once in a wooded nullah on the Baghi-Kadralla road.

**Hypocanthus spinoides.** The Himalayan Greenfinch.

Noted only in fairly open country at Mahasu, Mattiana, Baghi and Kadralla where it was occasionally observed.

**Passer domesticus.** The House Sparrow.

Like the Common Mynah the House Sparrow is common in the villages as far as Mattiana, where it is annoyingly evident nesting in the dak bungalow, but does not yet seem to have found its way further into the hills.

**Passer rutilans.** The Cinnamon Sparrow.

Not very common—seen only at Fagu, Baghi and Mattiana in the vicinity of the villages.

**Emberiza cia.** The Eastern Meadow Bunting.

Common throughout the area, favouring the more open country, constantly uttering its cricket-like 'cheep' and occasionally singing a twittering little song.

**Hirundo daurica.** The Red-rumped Swallow.

Frequently observed en route up to Narkanda and at Kadralla but not seen at Baghi. Often rests on the ground.

**Oreocorys sylvanus.** The Upland Pipit.

Noted on the scree covered hillsides near Mattiana and between Fagu and Theog—has a loud creaking note 'put — eeeeeee' and 'eeeeeee — put'.

**Zosterops palebroa.** The White-eye.

Noted only on one occasion at Mahasu.

**Aethopyga gouldiae.** Mrs. Gould's Sunbird.

This beautiful bird was seen occasionally in the Mahasu area feeding on flowering trees. Its call of 'Tzit zit — zit zit — ———' draws attention to its presence.

**Picus squamatus.** The Scaly-bellied Green Woodpecker.

Not often seen. Noted around Mahasu and in the Baghi forests.

**Hypopicus hyperythrus.** The Rufous-bellied Woodpecker.

This handsome little woodpecker is to be seen fairly frequently in the forest near Narkanda on the Rampur road. Observed drumming on a hollow tree trunk.

**Dryobates himalayensis.** The Himalayan Pied Woodpecker.

Fairly common in the Mahasu area and in the Narkanda-Baghi and Kadralla forests.

**Megalaema virens.** The Great Himalayan Barbet.

The mournful cry of this species; 'pee — oh' — can be heard in all the valleys en route up to Kadralla.

**Cuculus canorus.** The Asiatic Cuckoo.

The familiar 'Cuck-oo' call of this bird is heard everywhere and it is particularly common at Mattiana, Narkanda, Baghi and Kadralla. At these places also a loud, obviously cuckoo, call (somewhat reminiscent of the notes of the White-cheeked Bulbul) which may be expressed 'Quick, quick, drinking with you' is also very frequently heard. This was traced to a Cuckoo of the *canorus* type but whether *canorus*, *optatus*, or *poliocephalus* it was not possible to determine without procuring a specimen.

**Cuculus optatus.** The Himalayan Cuckoo.

Common—particularly so at Mahasu, Narkanda, Baghi and Kadralla. Its call *hoop hoop hoop hoop* is frequently evident at dawn, long after sunset and during moonlit nights.

**Cuculus micropterus.** The Indian Cuckoo.

Fairly common throughout the area and easily recognised by its call of *Make more pekoe*. Often calls before sunrise.

**Hierococcyx sparveroides.** The large Hawk-Cuckoo.

Heard at Mahasu, Narkanda, Baghi and Kadralla where it is common. Has the same ascending trill and call *Brain fever* as the Common Hawk-Cuckoo but less shrill. Also calls before sunrise and on moonlit nights.

**Cacomantis merulinus.** The Indian Plaintive Cuckoo.

Heard only on one occasion in the Mashobra Valley below Mahasu. Call: *how few, how few*.

**Upupa epops.** The Hoopoe.

Noted only at Fagu and Narkunda.

**Micropus pacificus.** Blyth's White-rumped Swift.

A flock of swifts identified as Blyth's Swift by the white rump and larger size than the House Swift were observed in flight below Mahasu before a storm. It is believed the Alpine Swift with its white underparts was also seen in the same locality.

**Collocalia fuciphaga.** The Himalayan Swiftlet.

Small flocks may occasionally be seen circling over the valleys usually preceding a storm.

**Strix nivicola.** The Himalayan Wood Owl.

Noted at Baghi. Call: *Hu-hoo* and *Huhu-hoo*.

**Otus spilocephalus.** The Himalayan Scops Owl.

The double whistle *phew.....phew* of this bird can be heard at night in the forests particularly at Mahasu and Narkanda.

**Sarcogyps calvus.** The King Vulture.

Not common—seen only on two occasions, once at Mahasu and once at Narkunda.

**Gyps himalayensis.** The Himalayan Griffon.

Common everywhere in the area.

**Pseudogyps bengalensis.** The White-backed Vulture.

Uncommon—seen once in flight over the Theog ridge.

**Neophron percnopterus.** The Neophron.

Fairly common throughout the whole area up to Baghi.

**Gypaëtus barbatus.** The Lämmergeier.

Fairly common everywhere—usually seen 'contouring' the hills with outstretched wings occasionally flexing, bearded head turning from side to side as every ravine and spur is examined.

**Falco peregrinus.** The Shahin Falcon.

A falcon in flight over the Mashobra valley below Mahasu and of which a close view was obtained was noted as a Shahin but the identification was not certain.

**Falco tinnunculus.** The Kestrel.

Fairly common—especially so around the steep hillsides near Narkanda and Baghi.

**Ictinaëtus malayensis.** The Black Eagle.

This fine bird was seen once,—skirting the edges of cliff forest and threading the trees on the side of Mount Hathu. Dark colour, fan tail and markedly upturned flight feathers are notable.

**Haematornis cheela.** The Crested Serpent-Eagle.

Seen on two or three occasions coasting with swept-back wings over the Mahasu—Kufri ridge uttering its loud whistling call.

**Milvus migrans.** The Common Pariah Kite.

Although common at Simla and at Mahasu the Common Kite does not seem to have moved further into the hills,—not even to Fagu—it was however observed once in flight crossing the saddle near Narkanda village.

**Sphenocercus sphenurus.** The Kokla Green Pigeon.

Noted in a deep forested ravine on the side of Mount Huttoo. The human-like whistle of this bird described by Whistler as *Why, we wait cheer; what are we waiting for?* immediately attracts attention.

**Columba livia.** The Blue Rock Pigeon.

Not common but a number seen at Mattiana and a pair at Baghi.

**Streptopelia orientalis.** The Rufous Turtle Dove.

Common—particularly so around Narkunda, Baghi and Kadrula. The speed at which this bird flies through the interstices of thick forest is rather astonishing.

**Streptopelia risoria.** The Indian Ring Dove.

Not common. Noted only at Mattiana where only one individual was seen.

**Pucrasia macrolopha.** The Koklas Pheasant.

Seen and heard in the Catchment Area forest near Mahasu.

***Geonaeus hamiltoni*.** The White-crested Kalij Pheasant.

Occurs fairly commonly in the Mahasu area but not noted elsewhere en route. Pheasants were heard (but unfortunately not seen!) in the Narkunda-Hathu Baghi area but lack of familiarity with their calls precluded identification. Mr. A. E. Jones, however, states that the Monal and the Western Horned Pheasant occur on Hathu.

***Arborophila torqueola*.** The Common Hill Partridge.

The low toned melancholy call *poo-or* of this bird is evident in the forests around Mahasu, Narkanda and Baghi.

***Alectoris graeca*.** The Chukor.

Seen on rocky hillside between Mattiana and Theog and heard near Baghi and Kadrula. Probably also occurs on the Theog scree slopes.

***Francolinus francolinus*.** The Black Partridge.

Noted in the valleys below Mahasu, Fagu, Theog, Mattiana and Narkanda. The grating call may be represented in the Morse code as 'TNK', i.e., '— — —' and is especially evident in rainy weather.

It may perhaps be emphasized that the foregoing record applies only to the period from the middle of May to the middle of June. The avifauna of any particular area in the hills is subject to considerable change—with seasons, of course, and with breeding periods, rainfall, food supply etc. The species observed in the area under discussion in October, for instance, will contain birds from the higher Himalayas and omit summer visitors (vide 'Some Birds Observed at Fagoo near Simla', H. Whistler, *J.B.N.H.S.*, October 20th 1919); species which are confined to a particular area whilst breeding will wander away therefrom before and after that period; a prolonged dry spell seems to be accompanied by a desertion of the hill tops and a descent to the valleys. Similarly, the ripening of crops and the flowering and fruiting of trees and bushes produce local movements. At any time of the year, however, a study of the birds of the Simla Hills is a most interesting subject.

## ADDENDA

As a result of a further visit to Mahasu and Narkanda during late May and early June this year (1946) some species were observed additional to those listed in the foregoing note. Further data are also available from Waite's paper on 'Birds on the Hindustan-Tibet Road, N-W. Himalaya' *J.B.N.H.S.* Vol. 45 part 4, page 531 so far as his account refers to the Mahasu-Narkunda-Baghi area and for the months of May and June. This information is given below with an indication of still other species which may be met with, although not at all common.

## (1) ADDITIONAL SPECIES NOTED IN MAY/JUNE 1946:—

***Stachyridopsis pyrrhops*.** The Red Billed Babbler.

Not common. Heard in the Catchment area below Mahasu in May. Call, a clear evenly pitched whistle of 5 to 9 notes.

***Microscellus psaroides*.** The Black Bulbul.

Small flocks seen in the tree tops on three or four occasions near Narkanda in early June.

**Culicivapaceylonensis.** The Grey Headed Flycatcher.

Uncommon. Seen in the Mahasu area at the end of May.

**Seicercus burkii.** The Black Browed Flycatcher Warbler.

Not common. Seen near Mahasu at the end of May in hillside forest scrub. This bird is a spring passage migrant.

**Glaucidium brodiei.** The Collared Pigmy Owllet.

Not previously noted but frequently seen and heard this year in the forests near Mahasu. Call, an oft-repeated four note whistle,—‘*poot putput poot*’, which carries a long way and is evident during the day as well as at dawn and dusk. (Waite states met with at Baghi in June.)

**Clamator jacobinus.** The Pied Crested Cuckoo.

Not at all common. Heard in the Mahasu area at the end of May. (Seen by Waite at Mattiana in June.)

The following species were seen this year in the Narkunda area in addition to the places previously noted:—

White Throated Laughing Thrush

Indian Blue Chat

Himalayan Greenfinch

Scaly-bellied Green Woodpecker.

## (2) ADDITIONAL SPECIES FROM WAITE'S PAPER:—

**Sitta leucopsis leucopsis.** The White-cheeked Nuthatch.

Specimen obtained between Baghi and Sungri in June.

**Siva strigula strigula.** The Stripe-throated Siva.

Male obtained at Baghi in June.

**Oreocincla dauma dauma.** The Small-billed Mountain Thrush.

Specimen obtained on Mount Huttoo on 24th June.

**Emberizafucata arcuata.** The Indian Grey-headed Bunting.

Few seen between Narkunda and Mattiana in June.

**Emberizastewarti** The White-capped Bunting.

Seen at Baghi in June.

**Cuculus poliocephalus poliocephalus.** The Small Cuckoo.

Obtained in June at Baghi.

## (3) ADDITIONAL SPECIES WHICH MAY BE MET WITH IN MAY & JUNE:—

The Green Shrike-Babbler.

The Fire-cap.

The Brown Hill Warbler.

Pallas' Willow-Warbler.

The Orange-gorgetted Flycatcher.

The Slaty Blue Flycatcher.

The Blue Rock-thrush.

The Brown Bullfinch.

The Himalayan Goldfinch.

The Black-naped Green Woodpecker.

The Brown-fronted Pied Woodpecker.

The Golden Eagle.

Bonelli's Eagle.

The Booted Eagle.

The Sparrow-hawk.

The Hobby Falcon.

The Monal Pheasant.

The Horned Pheasant.

The Woodcock.

The author's thanks are due to Mr. A. E. Jones who very kindly checked the list in paragraph (3).

# BREEDING AND DEVELOPMENT OF INDIAN\* FRESH-WATER AND BRACKISH-WATER FISHES.

BY

S. JONES, M.SC.

## Part I.

### INTRODUCTION.

In the course of a study of the breeding and developmental histories of some Indian fresh-water and brackish-water fishes, the literature on the subject was found by the author to be not only scanty but so scattered that he felt there was a real need to bring together in the form of a paper all the available information on the subject. It was just as he embarked on this work that the Editors of this *Journal* invited him to write a general article of this type in order to arouse interest on the subject among the members of the Society. This work is primarily intended for field naturalists rather than for specialists though the latter also may find it helpful.

Breeding and developmental studies of fishes are full of interest, and from the author's experience of the last few years, offer plenty of scope to anyone willing to devote some attention to them. These studies consist mainly of fieldwork and do not therefore require costly equipment and laboratories. Observations under aquarium conditions, though artificial, are still valuable, and interesting data can be obtained which can be checked later under natural conditions.

At a time when we hear from every quarter of the country the cry for the improvement of the fisheries so as to effect a greater production of fish and thereby to ensure a richer supply of food to the people, the importance of research on the life-histories, rate of growth, food, migrations, etc. of fishes cannot be over-emphasized. The information we have on the biology of Indian fishes is in no way comparable to the extensive knowledge accumulated as a result of years of well planned and systematically conducted research on the important fishes of the western countries. The little we know of a few fishes of this subcontinent is mostly from isolated observations and a great deal of further work is required before any practical use could be made of the knowledge. Though the following remark made by Dr. Stanley Kemp in 1938 in the course of an address at Cambridge to the Zoological Section (D) of the British Association does not exactly hold good at the present day, it helps to throw some light on the meagreness of our knowledge until quite recently. 'It is no great exaggeration to say that in Africa and almost throughout the stretch of the Indo-Pacific region there is scarcely a fish whose life history is fully known and whose various

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\* Including Burma and Ceylon.



stages from egg to adult can be recognized. Of such matters as age, rate of growth, spawning periods, food and migrations we are equally ignorant; nothing is known of the incidence of fluctuations and nothing in seasonal and other changes in the environment.'

In the case of each fish dealt with in this paper only brief notes on the work done so far are given and for detailed information the reader is recommended the original works. Though no pains have been spared to incorporate in this paper every available reference, any omission may be kindly brought to notice through the columns of this *Journal*. The account is confined to fishes that are known to live and breed or undergo larval development in fresh and brackish water including such essentially marine (anadromous) forms as frequent estuaries and ascend rivers for breeding purposes.

#### HISTORICAL RESUMÉ.

The literature on the subject of breeding and development of Indian fishes is hardly a century old and it belongs to two important periods. The first period consists mainly of the observations of the civil and military officers of the East India Company and the Government of India in the last century. This commences with Jerdon (1848) and is succeeded by Day (1873 & 1878) and Thomas (1870 & 1897). It can be considered a dormant period and the few incomplete notes we get are casual observations confined to breeding habits of some of the common forms with hardly any record on development. It is evident from these works that even in those days the study of the breeding habits of fishes with a view to improving the inland fisheries was engaging the attention of the Government.

The second period which is much more productive than the first begins with Willey (1908, 1910 & 1911) 'whose observations' as Raj (1916, p. 249) remarks 'on the breeding habits of *Ophicephalus striatus* and account of the nest, eggs and fry of some other species in his report on the inland fisheries of Ceylon are substantial contributions to our knowledge of the spawning habits of Indian fresh water fish'. About this time we get the notes by Jenkins (1910) and this is followed by the account of Raj in 1916 on the fresh water fish of Madras. The latter work is an important one as it is rich with his own observations on the breeding habits and development of a number of Madras forms and it has been brought up-to-date by the incorporation of all the previous facts known on the breeding and development of Indian fresh water fishes. His work on Hilsa in 1917 also deserves mention here. The faunistic investigations of the Zoological Survey of India in the Chilka Lake resulted in the work of Bhattacharya in 1917 on the eggs and early stages of three fishes there. Annandale has given in 1918 some notes on the breeding of fishes in the Inlé Lake, Burma, and Southwell and Prashad (1919) notes on certain stages in the development of a Notopterid. A very important work is that of Panikkar in 1920 supplemented by a note in

1924. In the former he has given detailed observations on the breeding season, nesting habits, parental care and early development of two South Indian Cichlids. We know through this work the time of attainment of sexual maturity of the two species—a thing we are practically ignorant of for many other Indian fresh water fish. Khan (1924 & 1926) has given notes on the breeding habits and development of some Punjab fishes and in 1928 of that of the Gold fish. The notes on the collections of gravid females and young larvae of a number of fishes from different localities in Ceylon by Deraniyagala (1929, 1930 & 1930-32) are very useful. The work of Aiyer (1935) on *Acentrogobius neilli* is remarkable in that it is the first account of a detailed nature on the development of any Indian fish though only the embryonic and the early larval stages are given, Jones in 1937 described the breeding and early development of seven Madras fishes and in 1938 of two Ceylon carps. In a paper by Job and Jones in 1938 the breeding and early development of two Synentognathi from Madras are dealt with. The recent work of Hora (1938) on *Hilsa* deserves particular mention here. There is a valuable paper on trout culture in Ceylon by Philip Fowke in 1938. Among the contributions of the last four years those of Kulkarni (1940 & 1943), of Chidambaram (1941), of Nair (1940), of Khan (1943), of Job (1940 & 1941), of Jones and Job (1940) and of Jones (1940, 1940a, 1941 and 1944) are the most important.<sup>1</sup>

We have abstracts of a number of papers (Raj 1917, Rao 1919, Rao 1934, Ahmed 1934 and 1936, Raj 1940 and Mukerjee 1943) from which very little useful information could be gathered due to their condensed nature. The original papers if published would have been very useful.

#### GENERAL NOTES ON BREEDING.

Notes on the breeding of Indian fishes have been given by several workers; but those given by Day and by Thomas during the later half of the last century still remain as some of the most outstanding contributions on the subject. Most of the forms dealt with are from South India.

The report on pisciculture in South Canara by Thomas (1870) is a very useful contribution and his observations hold good for the West Coast fishes in general as the whole region is similar in physical and climatic conditions. He says that the great majority of the small fish spawn in May, June and July (a few of them repeating the performance in October, November, December and January), and the spawning time of the mass of the big fish extends over September, October, November, December and January, but is chiefly confined to December and January.

Day (1873 & 1877), while dealing with the breeding of fishes in freshwater, speaks of the close relationship between breeding and

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<sup>1</sup> This article was communicated for publication early in 1944. The later publications on the subject will be given in the appendix at the end.

migration and divides the freshwater fishes into migratory and non-migratory fishes of the plains and migratory and non-migratory fishes of the hills. The migratory forms produce a larger number of eggs as the chances of survival are less than that of the non-migratory among which also a difference is noticed in that the monogamous deposit fewer eggs than the polygamous. He says that the migration for breeding takes place when the water courses are flooded and that considerable destruction is caused to the young fish due to improper methods of fishing when the waters subside.

Beavan (1877) while writing about the freshwater fishes of this country gives brief notes on the breeding habits of Ophicephalids, Siluroids and Cyprinids.

Willey (1911) says that the floods provide natural close season for the river fishes.

It may not be out of place to mention here the findings of Stewart (1911) on the breeding and migration of the fish on the Tibetan side of the Himalayas at a height of 13,100 feet. 'The breeding in the neighbourhood of Gyantse appears to occur about June. In the less favoured waters near the water-shed it is probably somewhat later. Adults with large ovaries and testes are found in the former district as early as March when the river is particularly covered with ice and the smaller streams and channels are completely frozen over'. Again he says 'All the inhabitants of Gyantse whom I consulted in regard to obtaining fish agreed that the larger fish migrated from the Nyangchu to the Brahmaputra (Tsay-po) for the winter and returned to breed in spring. It is certain that I did not obtain any large fish during this season, but this fact also could be accounted for by the hibernation of either the fish or the fishermen'.

Annandale (1918) who investigated the fish and fisheries of the Inlé Lake, Burma, says that according to the Intha fishermen almost all the fish of the lake breed in February, March and April. He found ripe or nearly ripe roes in all the species examined at the end of February and in March.

Wilson (1920) gives the following note on the migration of the fish during the spawning season in the Bhavani River (S. India). 'The big fish run up to the spawning grounds in the upper reaches of the Bhavani during the South-west Monsoon as soon as the higher water begins decreasing during August, September and October according to the season'.

The observations of Annandale and Hora (1920) show that the fish of Seistan on the Persian frontier north of Baluchistan, breed in winter as young specimens were collected at that time.

Generally speaking we do not have except in North India the different seasons so distinctly marked as in the cold countries. Observations of the present writer are confined to South India and he has found that the spawning period of the freshwater and brackishwater fishes is rather extended in this region, more so on the West Coast than on the East Coast due to the presence of two monsoon rains. The peak period in the former region is by the onset of the monsoon in May and June and the breeding continues

till November and December by which time the North-east Monsoon is over. The early showers towards the end of April and beginning of May give the first stimulus to the breeding activity. These rains flush the rivers and tanks; but the initial influx of water is not so great as to make them overflow. There is a marked increase in the planktonic organisms suitable for the growth of the fry and the absence of any floods at this time enables the eggs and fry to develop in comparative safety. By the onset of the regular rains the different waters get united and the fry as well as the large fish get themselves distributed. The condition is the same in both fresh water and brackish water areas and in the latter it has been seen that the breeding activity is at its maximum before the opening of the bars towards the end of June. Such of those marine forms that visit the estuaries or ascend rivers for breeding do so after the commencement of the regular rains when the bars are open. On the East Coast the breeding activity is at its maximum in August at the time of the early monsoon showers and it continues with intermittent intensity till about January. Among many of the South Indian fishes some degree of spawning is prevalent throughout the year especially in those parts where the climatic conditions do not show marked difference during the different parts of the year.

The fishes dealt with in this paper are listed below. The classification followed is that of Jordan<sup>1</sup>, with the genera under each family and the species under each genus arranged alphabetically.

Super Order: TELEOSTEI.

Order: ISOSPONDYLI.

Sub-Order: ELOPOIDEA.

Family: **Elopidae.**

*Elops indicus* Swainson.

Family: **Magalopidae.**

*Megalops cyprinoides* (Broussonet).

Sub-Order: CLUPEOIDEI.

Family: **Clupeidae.**

*Hilsa ilisha* (Ham.).

Family: **Eugranilidae.**

*Engraulis purava* (Ham. Buch.).

*Engraulis telara* (Ham. Buch.).

Sub-Order: NOTOPTEROIDEI.

Family: **Notopteridae.**

*Notopterus chitala* (Ham. Buch.).

*Notopterus notopterus* (Pallas).

Sub-Order: SALMONOIDEI.

Family: **Salmonidae.**

*Salmo gairdneri* Richardson.

<sup>1</sup> Jordan, D. S. 'Classification of Fishes', No. 2. Stanford University Pub. Vol. III, 1922-23.

## Order: OPISTHOMI.

Family: **Mastacembelidae.**

- Macrognathus aculeatus* (Bloch).  
*Mastacembelus armatus* (Lacep.).  
*Mastacembelus pancalus* (Ham. Buch.).

## Order: APODES.

Sub-Order: **ENCHELYCEPHALI.**Family: **Anguillidae.**

- Anguilla elphinstonei* Sykes.

## Order: EVENTOGNATHI.

Family: **Cyprinidae.**

- Amblypharyngodon melettina* (Cuv. & Val.).  
*Amblypharyngodon microlepis* (Bleeker).  
*Barbus ambassis* (Day).  
*Barbus amphibius* (Cuv. & Val.).  
*Barbus carnaticus* (Day).  
*Barbus chola* (Ham. Buch.).  
*Barbus conchoni* (Ham. Buch.).  
*Barbus chrysopoma* (Cuv. & Val.).  
*Barbus dorsalis* (Jerdon).  
*Barbus filamentosus* (Cuv. & Val.).  
*Barbus gelius* (Ham. Buch.).  
*Barbus lateristriga* (Cuv. & Val.).  
*Barbus melanampyx* (Day).  
*Barbus phutunio* (Ham. Buch.).  
*Barbus sarana* (Ham. Buch.).  
*Barbus sophore* (Ham. Buch.).  
*Barbus stoliczkanus* (Day).  
*Barbus terio* (Ham. Buch.).  
*Barbus ticto* (Ham. Buch.).  
*Barbus titteya* (Deraniyagala).  
*Barbus tor* (Ham. Buch.).  
*Barbus vittatus* (Day).  
*Barilius bendelisis* (Ham. Buch.).  
*Barilius gatensis* (Cuv. & Val.).  
*Brachydanio albolineatus* (Blyth).  
*Brachydanio nigrofasciatus* (Day).  
*Brachydanio rerio* (Ham. Buch.).  
*Carassius auratus* (Linn.).  
*Catla catla* Cuv. & Val.  
*Cirrhina mrigala* Ham. Buch.  
*Cirrhina reba* Ham. Buch.  
*Danio malabaricus* (Jerdon).  
*Danio neilgherriensis* (Day).  
*Esomus danrica thermoicos* (Cuv. & Val.).  
*Esomus danricus* (Ham. Buch.).  
*Garra ceylonensis ceylonensis* (Bleeker).  
*Garra mullya* (Sykes).  
*Gymnocypris waddellii* Regan.  
*Labeo bata* (Ham. Buch.).  
*Labeo calbasu* (Ham. Buch.).  
*Labeo gonius* (Ham. Buch.).  
*Labeorohita* (Ham. Buch.).  
*Rasbora daniconius* (Ham. Buch.).  
*Rasbora maculata* Duncker.  
*Rasbora labiosa* (Mukerji).  
*Rasbora rasbora* (Ham. Buch.).  
*Rasbora taeniata* Ahl.

Family: **Cobitidae.**

*Botia geto* (Ham. Buch.).  
*Lepidocephalichthys thermalis* (Cuv. & Val.).  
*Nemacheilus notostigma* (Bleeker).  
*Nemacheilus zonatus* (McClelland).

Order: NEMATOGNATHI.

Family: **Siluridae.**

*Callichrous bimaculatus* (Bloch).  
*Wallagonia attu* (Bloch).

Family: **Ariidae.**

*Arius falcarius* Richardson.  
*Arius jaius* (Ham. Buch.).  
*Arius jella* Day.  
*Arius sona* (Ham. Buch.).  
*Osteogobius militaris* (Linne).

Family: **Bagridae.**

*Gagata cenia* (Ham. Buch.).  
*Mystus aor* (Ham. Buch.).  
*Mystus gulio* (Ham. Buch.).  
*Mystus seenghala* (Sykes).  
*Mystus vittatus* (Bloch).

Family: **Clariidae.**

*Clarias teysmanni* Bleeker.

Family: **Heteropneustidae.**

*Heteropneustes fossilis* (Bloch).

Family: **Sisoridae.**

*Sisor rhabdophorus* Ham. Buch.

Order: CYPRINODONTES.

Family: **Cyprinodontidae.**

*Aphanius dispar* (Rüppel).  
*Aplocheilichthys blockii* (Arnold).  
*Aplocheilichthys lineatus* (Cuv. & Val.).  
*Aplocheilichthys panchax* (Hamilton).  
*Oryzias melastigma* (McClelland).

Family: **Poeciliidae.**

*Gambusia affinis holbrooki* (Girard).  
*Lebistes reticulatus* (Peters).

Family: **Horaichthyidae.**

*Horaichthys setnai* Kulkarni.

Order: SYNENTOGNATHI.

Family: **Belontiidae.**

*Tylosurus strongylurus* (van Hass.).

Family: **Hemiramphidae.**

*Dermogenys burmanicus* Mukerji.  
*Hemiramphus gaimardi* (Cuv. & Val.).

## Order: LABYRINTHICI.

Family: **Ophicephalidae.**

- Channa orientalis* Bloch & Schneider.  
*Ophicephalus gachua* Ham. Buch.  
*Ophicephalus marulius* Ham. Buch.  
*Ophicephalus punctatus* Bloch.  
*Ophicephalus striatus* Bloch.

Family: **Polyacanthidae.**

- Belontia signatus* Gunther.

Family: **Osphromenidae.**

- Betta splendens* Regan.  
*Colisa fasciata* (Bloch & Schnn.).  
*Colisa labiosa* (Day).  
*Colisa lalia* (Ham. Buch.).  
*Macropodus cupanus* (Cuv. & Val.).  
*Osphronemus goramy* (Lacép.).  
*Trichogaster trichopterus* (Pallas).

Family: **Anabantidae.**

- Anabas testudineus* (Bloch).

## Order: PERCOMORPHI.

## Sub-Order: PERCESOCES.

Family: **Mugilidae.**

- Mugil sp.*

## Sub-Order: RHEGNOPTERI.

Family: **Polynemidae.**

- Polynemus paradiseus* Linn.

Family: **Ambassidae.**

- Ambassis lala* (Ham. Buch.).  
*Ambassis miops* Gunther.  
*Ambassis nama* (Ham. Buch.).  
*Ambassis ranga* (Ham. Buch.).

Family: **Latidae.**

- Lates calcarifer* (Bloch).

Family: **Theraponidae.**

- Pelates quadrilineatus* (Bloch).  
*Therapon jarbua* (Forsk.).  
*Therapon therapos* (Cuv. & Val.).

Family: **Sillaginidae.**

- Sillago sihama* (Forsk.).

Family: **Nandidae.**

- Badis badis* (Ham. Buch.).  
*Nandus nandus* (Ham. Buch.).

## Sub-Order: SQUAMIPENNES.

Family: **Toxotidae.**

- Toxotes chatareus* (Ham. Buch.).

Family: **Scatophagidae.**

- Scatophagus argus* (Gmel. Linn.).



Order : CHROMIDES.

Family : **Cichlidae.**

*Eetroplus maculatus* (Bloch).  
*Eetroplus suratensis* (Bloch).

Order : GOBIOIDEA.

Family : **Gobiidae.**

*Acentrogobius neilli* (Day).  
*Acentrogobius viridipunctatus* (Day).  
*Ctenogobius acutipinnis* (Cuv. & Val.).  
*Glossogobius giuris* (Ham. Buch.).  
*Gobius ostericola* Chaudhuri.  
*Oxyurichthys striatus* (Day).

Family : **Periophthalmidae.**

*Boleophthalmus boddaerti* (Pallas).  
*Periophthalmus cantonensis pearsi* Eggert.

Order : JUGULARES.

Family : **Blennidae.**

*Petroscirtes bhattacharyae* Chaudhuri.

**Elopidae.**

*Elops indicus* (Swainson).

Raj (1916) says that breeding is in the cold season and that the fry are ribbon shaped.

**Megalopidae.**

*Megalops cyprinoides* (Broussonet).

Thomas (1870) says that the breeding season of this fish in South Canara extends from May to June and Raj (1916) says that it breeds in the cold weather (October and November) and that it passes through the larval stage like that of an eel.

**idae.**

Among the clupeids the spawning habits of *Hilsa ilisha* or the so-called Indian Shad has engaged from the very early times the attention of the pisciculturists. Till the recent investigations of Hora, Prashad and Nair the habits of the fish were not known definitely. Their findings go to show that *Hilsa* actually reside in the rivers and that 'after leaving the rivers the fish do not go far into the sea but move about in shoals in the estuaries and along the foreshores'.

*Hilsa ilisha* (Hamilton).

Day (1873) has first referred to the migratory habits of this form, pointing out the fact that both young as well as sexually mature fish ascend the rivers. According to him the fish attains sexual maturity when about two years old and this is confirmed by the findings of the Madras Fisheries Department. He (Day 1878) has given the migratory period of the fish in some of the rivers of India and Burma and stressed on the destruction caused to these fisheries by the numerous weirs that span many of the Indian rivers devoid of fish passes which otherwise would enable them to get at the upper reaches of the rivers for spawning purposes. Wilson (1909) succeeded in artificially fertilising *Hilsa* eggs at Coleroon and this was the starting of a scheme towards the artificial propagation of this form. Jenkins (1910) gives notes on its habits in Bengal and there is a brief note by Raj (1917) on the artificial propagation in the Coleroon hatchery where he succeeded in liberating about 10 million fry from artificially impregnated eggs in August 1916. This work

is being continued regularly by the Madras Fisheries Department (Devanesan, 1939).

The recent work of Hora (1938) on the spawning habits and bionomics of this form is a fairly detailed and comprehensive account embracing all the previous work done on this line with special reference to that done in Bengal and embodying the results of his own investigations, and a complete bibliography. The observations of Hora at Pulta, and of the Madras Fisheries Department in South India, go to show that the fish is capable of living in confined waters. The breeding period is extensive with a maximum during the rainy season.

Nair (1939) has described some of the early larval stages, 14 to 27 mm. in length collected from the Pulta Water Works, Calcutta, where the young are found in great abundance from March to November. Eggs and very early larval stages have not been collected from the Hooghly.

Hora (1940) refers to the importance of the conservation of Jatka fish, young Hilsa 2-5 months old, for the Hilsa fishery. He (1941) gives an account of the life history and habits of *Hilsa* in Bengal waters.

#### Engraulidae.

*Engraulis purava* (Ham. Buch.)

Raj (1916) refers to the occurrence of the young of this form in Cooum river, Madras, during October and November. Dr. T. J. Job and the present writer have collected the larvae of *E. purava* in March from Adyar, Madras.

*Engraulis telara* (Ham. Buch.)

Day (1878) gives the colouration of the pectoral fins of the young.

#### Notopteridae.

*Notopterus notopterus* (Pallas)

There is a note by Rao (1919) in which he says that the 'eggs adhere to each other and to the substratum on which they are deposited in clumps'. Nothing more regarding its breeding habits or development is known.

*Notopterus chitala* (Ham. Buch.)

Notes on the breeding habits and development of this form based on the observations made, and materials collected, by Mr. Hoshin at Buxar (Bihar) from the Ganges are given by Southwell and Prashad (1919). The eggs were collected in June and July 1915 and these were attached mostly to stones and masonry where they had been deposited by the female before fertilization. There is no elaborate nest building and the eggs measuring about 5.2 mm. in diameter usually number from three to five hundred and are circular with an adhesive surface which is raised into projections on one side. The eggs take about two weeks to hatch and there is parental care but which of the parent takes the main part is not known. The breeding of this fish probably extends from the end of May to the middle of July.

#### Salmonidae.

*Salmo gairdneri* Richardson

There is an interesting and exhaustive account on trout culture in Ceylon by Fowke (1938) wherein notes on the life-history of the trout acclimatized in the Ceylon waters is given. The observations of Fowke throw considerable light on the identity of the species and he has given sufficient reasons to show that the Trout in Ceylon is not the Rainbow (*S. shasta*) as is generally believed to be but the Steelhead. The article provides interesting and instructive reading and may be gone through with advantage.\*

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\* For a comprehensive account on trout culture the 'Domesticated Trout' by Livingston Stone may be consulted.

**Mastacembelidae.***Mastacembelus panacalus* (Ham. Buch.)

Raj (1916) gives the description of an immature fish and mentions the cold season as the breeding period. Job (1941) gives a detailed account of the breeding habits and development of this form and according to him the fish breeds in Bengal from May to November with the peak period during the premonsoon rains. The eggs are transparent and measure 1.3 to 1.35 mm. in diameter and are laid feebly attached to algae. Hatching takes place 36 hours after oviposition and there is no parental care. The early larval development is rather rapid and the fish acquires adult characters by the end of the first month. Sexual maturity is attained in about an year.

*Mastacembelus armatus* (Lacép.)

Raj (1916) records mature ova in a specimen he collected early in February 1910. Deraniyagala (1930-32) gives a number of places in Ceylon from where young specimens, and fish with mature eggs were collected. The writer has collected young specimens of this fish in August 1938 from a tank in Central Travancore.

*Macrogathus aculeatus* (Bloch)

Deraniyagala (1930-32) describes the eggs and gives a number of places in Ceylon from where sexually mature specimens were collected.

**Anguillidae.**

Members of this family are known to migrate to the sea for breeding purposes and the young ones after passing the larval (Lepidoccephalus) stage in the sea ascend rivers during the elver stage.

*Anguilla elphinstonei* Sykes.

According to Raj (1916) the elvers ascend the Adyar and Cooum rivers in Madras about the month of November.

**Cyprinidae.**

This family embraces the Carps, the most important group of fresh-water fishes in India. Though complete life histories of only a very few forms are known we have notes on the breeding habits of a number of them. The intensive sexual activity and migratory habits of these fishes soon after the first monsoon rains are well known. They are so reckless at this time that they are captured with comparative ease by fishermen. Thomas (1870 and 1897), Day (1873 etc.), Beavan (1877), and Jones (1940) have mentioned about the spawning activity of Cyprinids. This has been a familiar and favourite subject of study for many naturalists. Khan (1924, 1926, 1939 & 1943) has made some interesting studies on the spawning habits of some of the Punjab forms and the present writer has worked out the life histories of two forms in Ceylon (Jones, 1938 a & b). As Khan (1926) says, 'To this group belongs a vast number of edible and sporting fishes and their culture should be the main object of a pisciculturist'.

Beavan (1877) says that 'the Mahseer and many other Cyprinoid fish, are said not to deposit their spawn all at once like the salmon, but in several batches during a period of several months, say from May to August'.

Some of Khan's (1924) observations are given below:—

'All attempts to breed members of the family Cyprinidae, namely *Labeo rohita*, *L. calbasu*, *Cirrhina mrigala* and *Catla catla* in artificial waters have proved failures. Unlike their western species they do not lay their eggs, even when brood fish from river are introduced into the tanks. The experiments were tried at the departmental hatcheries at Madhopur but no result was obtained. One of the main reasons for our failures is the want of knowledge of their breeding habits in their natural environments.'

'The fish become ripe in May and both the male and female seek shelter under weeds and aquatic plants near banks and are not easily frightened by the approach of intruders. Towards evening group of fish may be seen

splashing water and fighting with each other. These are signs of courtship! And thus they wait for the first shower of rain. If there is no rain at all or if they are late the eggs degenerate in the ovaries, leaving a filthy mass. In July as soon as the rains set in, the streams become flooded and the fish move on to shallow waters. If the flood is of a temporary character they fall back into the main channel with the diminishing current without spawning, but if the floods are continuous the fish get into the surrounding fields, play together, lashing the water with their caudal portions. A female is often followed by three or more males, but reverse cases have also been observed. Very rarely are single couples seen. If male is separated from a companion or is companionless it has been heard to produce guttural sounds calling the other. This play lasts only for a short time and the female then lays its eggs which are nonfloating and the males shed their seminal fluid or milt over or near them. Depth of water in fields where spawning takes place varies from three inches to two feet, and temperature of water ranges from 76° to 98° F. Sometimes when the flood subsides early, little pools are formed by the depression and there the eggs are found in 'heaps'.

'The eggs are not laid at one place and at the same time, but at intervals during which the fish keeps on moving with its mates along with the current of water. The rivers are flooded first and the fish therein are the first to spawn while those of the tributaries wait for heavy rains which flood them sufficiently to overflow into the fields where spawning takes place. The breeding time thus lasts from the beginning of July to the middle of August'.

Khan (1938 a) says that the breeding time for the Indian Carp is June and July when the rivers are flooded by the monsoon rains. Administration of extract of anterior lobe of the pituitary gland hastened ovulation in *Cirrhina mrigala* and as such under natural conditions the pituitary sex hormone is discharged into the blood prior to ovulation though the factors responsible for this gland activity are not known.

It may be mentioned here that the author has been able to collect the eggs of a number of Cyprinids, from fresh water tanks and lakes in Travancore, which are not described here as their parentage has not been ascertained. The embryonic period is of very short duration as in the other members of the family, some hatching out within twelve hours. In two species two very interesting types of larval 'cement organs' the like of which have not been recorded in any other fish have been observed. (Jones, 1942).

*Labeo calbasu* (Ham. Buch.)

Mukerjee (1943) says that the fry have yellow bands at the nape, a yellowish spot at the place of insertion of the dorsal fin and yellow colour, sometimes alternating with the black of the body whereas the adult is completely black.

*Labeo genius* (Ham. Buch.)

Khan (1924 & 1926) has given notes on the embryonic and early development of this form till it is three weeks old, when the caudal fin get separated off and scales appear. The eggs, which are bluish in colour, hatch in about 30 to 40 hours and mouth, gut and anus are absent in the larvae at this stage. Mukerjee (1943) gives a note on the colouration of the fry.

*Labeo rohita* (Ham. Buch.)

Mukerjee (1943) says that the fry have three small spots in the caudal region which gradually merge into one and ultimately disappear in the adult.

*Labeo bata* (Ham. Buch.)

Mukerjee (1943) refers to the presence of a spot on the 5th and 6th scales on the row just above the lateral line in the fry.

*Barbus sarana* (Ham. Buch.)

Mukerjee (1943) refers to the presence of a linear band on the back below the insertion of the dorsal fin which gradually gets rounded and disappears in the adult.

*Barbus chrysopoma* (Cuv. & Val.)

According to Day (1878) the eyes in the young are comparatively large. Raj (1916) says that the breeding season at Madras is about December as the young are common in January and February. He gives the description of specimen one inch long. Deraniyagala (1930) has collected young in December in Ceylon.

*Barbus tor* (Ham. Buch.)

The migratory habits of this form for breeding purposes are well known, and being a game fish as well as food fish it has engaged the attention of naturalists and anglers from very early times. According to Beaven the fish lays its eggs in several batches for a long period mainly from May to August. Thomas (1897) gives in detail the migration and breeding habits of this fish. According to him, the fish ascend the rapids and eggs are laid there after which they return with the receding floods. His opinion was that the Mahseer\* lays several batches of eggs probably three in one season. Khan (1924) also refers to the migratory habits of this form during breeding season, and in the Punjab the fish has been found to ascend the rivers and traverse long distances in March and April. Deraniyagala records his collection of gravid female, and young specimens from a number of places in Ceylon (Deraniyagala 1930). Khan (1939) has made an interesting study of the sex organs of this form and in conclusion says that the fish 'seems to spawn *firstly* in winter, in January and February, *secondly*, in May and June, when the snow melts and the rivers are swollen, and *thirdly*, from July to September, when the rivers are flooded with the monsoon rains'. He refutes the opinion of Thomas (1897) that the fish lays eggs in batches and says as follows: 'It may, therefore, be said that the Mahseer does not lay its eggs in three batches, but that it spawns three times in the year, and that all the eggs in the ovaries are laid at each spawning season'.

*Barbus sophore* (Ham. Buch.)

Day (1878) records the presence of 1850 mature eggs in a female at Madras in January. Raj (1916) says that it breeds during the cold weather and the young are common in November and December. He gives some of the larval characters.

*Barbus carnaticus* (Day)

Day (1878) mentions some of the characters of the young of this form.

*Barbus melanampyx* (Day)

The writer has observed large numbers of the young of this fish in hill streams in Travancore in the months of August and September 1940.

*Barbus chola* (Ham. Buch.)

Notes on the breeding habits of this fish is given by Innes (1935). Stoye (1935) says that the habits are similar to that of *B. conchoniis*.

*Barbus dorsalis* (Jerdon)

Willey (1911) describes a collection of unfertilized eggs from the Colombo lake. According to Raj (1916) the spawning season in Madras extends from August to October. Deraniyagala (1930) gives the names of the places in Ceylon from where he collected ripe females, and young with the corresponding dates.

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\* Mahseer is the popular name given to most of the large scaled Carps of the Genus *Barbus*.

*Barbus amphibius* (Cuv. & Val.)

According to Thomas (1870) this form breeds during October, November and December in South Canara. Raj (1916) observes that its breeding season is during June and July in Madras. He gives the colouration of the young.

*Barbus ambassis* (Day)

According to Spence and Prater (1932) breeding season is as in *Barbus filamentosus*.

*Barbus conchoniis* (Ham. Buch.)

The breeding of this fish in the aquarium is given by Baake (1930) and by Innes (1935). According to the latter it is easier to breed this fish than *B. chola*. Mellen & Lanier (1935) and Stoye (1935) also give the breeding of it in the aquarium. It begins to breed when five months old and lays 150 to over 600 eggs scattered among the vegetation and the fry hatch out in about one and a half days at a temperature of about 70 to 75° F. The fry cling on to plants and sides of the aquarium indicating the presence of cement glands. The young seem to have cannibalistic tendencies.

*Barbus ticto* (Ham. Buch.)

Innes (1935) gives the distinguishing characters of the sexes during the breeding season. Mellen and Lanier (1935) and Stoye (1935) say that the breeding habits resemble those of *B. conchoniis*. Spawning temperature is 80° F. and from 150 to 300 eggs are laid scattered among the vegetation. Fraser (1937) refers to the presence of very young specimens at Deolali in November and egg bearing females in March. Khan (1938) says that this fish and *B. stigma* breed in July and August in the Punjab and the eggs which are small hatch out in 18 to 20 hours and the young begin to seek their food after a week.

*Barbus stoliczkanus* (Day)

Innes (1935) says that this species is said to be prolific and as hardy as *B. ticto*. According to Mellen & Lanier (1935) and Stoye (1935) the breeding habits are similar to those of *B. conchoniis*. The spawning temperature is 80° F.

*Barbus gelius* (Ham. Buch.)

Innes (1935) refers 75° F. as the optimum temperature required for the breeding of this form and Mellen & Lanier (1935) give it at 80° F. Stoye (1935) gives some notes on the breeding of the fish in the aquarium. All refer to the spawn eating tendency of the parents. The embryonic period is 36 hours and the larvae are probably provided with adhesive glands.

*Barbus phutunio* (Ham. Buch.)

Notes on the breeding habits in the aquarium are given by Innes (1935). Mellen & Lanier (1935) say that the breeding habits are similar to those of *B. conchoniis*. It breeds at 76° F. and the embryonic period is from 30 to 40 hours. Stoye (1935) gives similar notes on the fish under aquarium conditions.

*Barbus terio* (Ham. Buch.)

According to Innes (1935) the breeding and care of this fish is the same as in the case of *B. conchoniis* though it does not spawn so readily.

*Barbus vittatus* (Day)

Day (1878) gives the coloration of the very young specimens. Innes (1935) says that this is a good breeder in the aquarium. Mellen and Lanier (1935) say that though the sexes are difficult to be distinguished the colour of the

male becomes more vivid and the abdomen of the female becomes deeper during the breeding season. The breeding habits are similar to that of *B. conchoni*, 50 to 250 eggs are laid and the spawning temperature is 78° F. Stoye (1935) says that this fish is not so prolific as *B. conchoni*.

*Barbus filamentosus* (Cuv. & Val.)

Deraniyagala (1930) lists a number of places in Ceylon from where he collected gravid females. Spence and Prater (1932) say that in Bombay and its neighbourhood the breeding is in December and that the young are found in January.

*Barbus lateristriga*\* (Cuv. & Val.)

Mellen and Lanier (1935) give 80° F. as the spawning temperature in the aquarium and Stoye (1935) gives the distinguishing characters of the two sexes during breeding season.

*Barbus titteya* (Deraniyagala)

Deraniyagala (1930) has collected young from different places in Ceylon.

*Cirrhitina reba* (Ham. Buch.)

Mukerjee (1943) says that the fry differs from the adult in having three spots in the caudal region which later on unite with a lateral blue black line in the adult.

*Cirrhitina mrigala* (Ham. Buch.)

According to Khan (1926) the eggs are light red and the development as that in *Labio gonius*. He (1943) has given a detailed account of the early development of this fish in the Punjab. The breeding is in July as in other carps and a female contains 124,800 to 216,800 eggs. The young gets adult characters in a month. Mukerjee (1943) gives a note on the difference in colouration between the fry and the adult.

*Garra ceylonensis ceylonensis* (Bleeker)

Deraniyagala (1930) records with their respective dates a number of places from where young of this form was collected by him in Ceylon. The life history of this form has been worked out by Jones (1938 & 1941). The embryonic development was worked out in Demodera, Ceylon. Soon after hatching, the larvae were brought down to Colombo and from there to Tambaram (Madras). One of the surviving young fish when about 5 months old was brought to Trivandrum from Madras where it lived for another 3 months. Thus the larval and the post-larval development has been worked out in India.

*Garra mullya* (Sykes)

Fraser (1937) records the presence of egg bearing females in Deolali in the month of March 1936. Jones (1941) has described an interesting case of migration of this fish for breeding in large shoals in one of the up-country rivers in Travancore in the month of April. The early development of the fish is similar to that in *Garra ceylonensis ceylonensis*.

*Barilius bendelisis* (Ham. Buch.)

Day (1878) refers to the large sized nature of the eggs and the breeding of this form at Cuttack in November. Fraser (1937) has observed gravid females in March.

*Barilius gatensis* (Cuv. & Val.)

Day (1878) gives the difference in the scales of the females and young from that of the male.

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\* This is a native of the East Indies and has been introduced into India as an aquarium fish.



*Danio malabaricus* (Jerdon)

The breeding of this species in the aquarium is mentioned briefly by Innes (1935) and Mellen & Lanier (1935) and Stoye (1935). The breeding habits and early development of this form in Ceylon were worked out by Jones (1938). The presence of a cement organ recorded for the first time is another feature of interest. The developmental study was carried out at Demodera (3000 ft.), Uva Province, Ceylon, during the months of April, May and July, 1937. Young fish of different stages were abundant at this time in the streams there showing a long period of breeding.

*Danio neilgherriensis* (Day)

Day (1878) mentions the presence of light horizontal bands in the young.

*Carassius auratus* (Linn.)

This beautiful fish introduced from the Far East is a very common aquarium form now in India. Khan (1928) gives notes on the spawning and development of this form. According to him it breeds at frequent intervals (in the Punjab) from April to August and the eggs hatch out in 46 to 60 hours. Three months old fry assume the coloration of the adult. There are several accounts on the breeding of this fish in other countries (see Mellen & Lanier, 1935, for references.) From 2000 to 70,000 eggs are laid in a year according to the size of the female and eggs are small and resemble soap bubbles. The parents are spawn eaters and the young are cannibalistic. 60° to 70° is the spawning temperature.

*Esomus danrica thermoicos* (Cuv. & Val.)

Deraniyagala (1930) refers to his collection of fishes with mature cva from Athidiya, Ceylon, early in April, 1929.

*Esomus danricus* (Ham. Buch.)

The spawning habits of this fish in the aquarium are described by Innes (1935) and by Mellen & Lanier (1935) and Stoye (1935). The spawning temperature is about 80° F. and 75 to 250 eggs which are small and pale yellow in colour are laid feebly attached to plant. The parents are spawn eaters and the eggs hatch in two to three days.

*Catla catla* (Cuv. & Val.)

Raj (1916) says that in Godavari River this form breeds about August and young specimens are common in January. He refers to the rapid growth as observed by Mitchell (1875). Mukerjee (1935) says that in the fry the red tinge of the gill filters out through the transparent operculum. Though this fish grows well in still waters it does not breed there.

*Amblypharyngodon microlepis* (Bleeker)

According to Raj (1916) the breeding season extends from October to December at which time he says the fry are quite common. He gives a description of the fry.

*Amblypharyngodon melettina* (Cuv. & Val.)

Wiley (1911) says that females three inches long are found egg-laden in December in Ceylon. Deraniyagala (1930) refers to the development of a cutaneous symphysal flap over-lapping the upper jaw during breeding seasons.

*Rasbora daniconius* (Ham. Buch.).<sup>1</sup>

Raj (1916) observes this to breed during rains in September and October in Madras, where it is common during the breeding season along with the

<sup>1</sup> The development of this fish has since been worked out by the author.

fry of *Amblypharyngodon*, *Nauria danrica* and *Barbus vittatus*. Deraniyagala (1930) collected gravid females from a number of places in Ceylon. Innes (1935), Mellen and Lanier (1935) and Stoye (1935) give notes on the breeding of this fish in the Aquarium. The spawning temperature is 80° and eggs are attached to fine plants.

*Rasbora rasbora* (Ham. Buch.)

According to Thomas (1870) this form breeds in June and July in the West Coast.

*Rasbora labiosa* Mukerji.

Hora (1937) has collected young of this form in November, and gravid females in February.

*Rasbora maculata* Duncker.

Mellen and Lanier (1935) say that the spawning temperature is 80° and that the eggs are deposited on the under surface of leaves. Stoye (1935) gives the distinguishing features of the male fish.

*Rasbora taeniata* Ahl.

The spawning temperature of this fish is about 80° and about 250 eggs are laid at a time. (Innes, 1935, Mellen & Lanier, 1935, and Stoye 1935.)

*Gymnocypris waddellii* Regan.

Stewart (1911) says that in the ripe specimen the mature ova attain the impressive size of 2.5 mm.

*Brachydanio rerio* (Ham. Buch.)

Innes (1935), Mellen and Lanier (1935) and Stoye (1935), give notes on the breeding of the fish in the aquarium and the method of rearing of the larvae. Innes (op. cit.) refers to the occurrence of sterile hybrids of *B. rerio* and *B. nigrofasciatus*. The male is brightly coloured during the breeding season and from 150 to 350 transparent eggs are laid by the female. The parents are spawn eaters. The larvae come out in about 2 days and appear to be provided with adhesive glands which enable them to cling to the sides of the aquarium for about two days. The spawning temperature is about 80°

*Brachydanio nigrofasciatus* (Day)

The breeding habits of this species are given by Innes (1935) and Mellen and Lanier (1935) in the aquarium and they refer to the difficulty of breeding it. The spawning temperature is about 80°. Stoye (1935) gives notes on the breeding of the fish.

*Brachydanio albolineatus* (Blyth)

Baake (1930) gives notes on the care of this fish in the aquarium and its breeding habits. Innes (1935), and Mellen and Lanier (1935) also refer to the breeding of this fish in the aquarium which are similar to those of *B. rerio*. The young develop rapidly and attain sexual maturity in six months. Stoye (1935) says that the breeding habits are similar to those of others of the group.

#### Cobitidae.

*Nemachilus zonatus* (McClell.)

Day (1878) gives the colouration in the young.

*Nemachilus notostigma* Bleeker

Deraniyagala refers to his collection of young of this form in Ceylon.

*Lepidocephalichthys thermalis* (Cuv. et Val.)

Day (1878) records the presence of 2,500 eggs in a female. According to Raj (1916) the breeding season in Madras extends from October to January. Deraniyagala (1930) has collected gravid females in Ceylon.

*Botia geto* (Ham. Buch.)

Day (1878) gives the larval characters of this form.

**Siluridae.***Wallagonia attu* (Bloch)

Khan (1924 & 1926) has given notes on the early development of this form and Ahmed (1934) gives a brief note on its embryology. Deraniyagala (1930-32) has collected female specimens with mature ova from Kelaniya (Ceylon) on 25-2-27. The present writer has taken a very young specimen from a tank in Trivandrum during the middle of May 1938. According to Khan the eggs are yellowish and hatch out in twenty-four hours. The fry is omnivorous with cannibalistic tendencies.

*Callichrous bimaculatus* (Bloch)

Rao (1919) gives a short note on the development of this form. Deraniyagala describes the eggs and records the collection of ovigerous females and young specimens in Ceylon.

**Aridae**

The buccal incubation recorded in some of the members of this family whose breeding habits are known is so interesting that it practically eclipses the parental solicitude displayed by other fishes. The eggs are heavily yolked, large in size and few in number and these are carried in the mouth of the male. They are aerated by the respiratory current of water and the egg bearing male never feeds during this period. The larvae are also carried inside the mouth until they are able to take care of themselves. Notes on the spawning habits are given by Day (1878), Willey (1910), Jenkins (1910), Raj (1916), Deraniyagala (1930-32), and Chidambaram (1941).

*Arius falcarius* Richardson.

Willey (1911) has recorded the buccal incubation in this form and gives a description of the eggs and the egg carrying males. Raj (1916) gives the breeding habit according to which the spawning season extends from September to November, when large numbers congregate in estuaries to deposit their spawn.

*Arius sona* (Ham. Buch.)

This is a marine and estuarine form and Day (1889) gives the characters of the young specimens.

*Arius jella* (Day)

Chidambaram (1941) describes in some detail the parental care and early development of this fish at Madras where the breeding extends from August to March. The eggs are heavily yolked and yellowish green in colour and measure from 10 to 10.5 mm. in diameter. Soon after oviposition the eggs are fertilized by the male and transferred to its mouth where they undergo the embryonic development. They hatch after a month and the larvae continue to remain inside the buccal cavity for about another month by which time the yolk sac gets completely absorbed. The male does not feed during the whole period.

*Arius jatius* (Ham. Buch.)

Jenkins (1910) records the capture of a larvae-carrying male while shrimp trawling in the Culputtoon River in Khulna District.

*Osteogeniosus militaris* (Linne)

This is a marine and estuarine form and Jenkins (1910) describes the egg and parental care of this species. Similar notes are given by Deraniyagala (1930-32) according to whom *O. sithenocephalus* Day is probably a sexual modification of *O. militaris*.

**Bagridae.***Mystus vittatus* (Bloch)

Raj (1916) refers to his collection of ovigerous females in the month of March.

*Mystus gulio* (Ham. Buch.)

According to Day (1878) and Willey (1911) the eggs of this species are small sized as in the related forms. Eggert (1930) suggests that the female of this form may have the habit of carrying the eggs in the folds of its abdominal skin.

*Mystus aor* (Ham. Buch.)

Raj (1940) has recorded for the first time the interesting breeding habits of this form. It is suspected that the eggs are incubated by the male attached to its ventral side which is thrown into vascular folds. The young on hatching out remains in a shoal under the parent and for some period appear to get nourishment from a white fluid exuding from the highly vascularised villiform processes of the ventral surface. Some of the larval stages of the fish are described.

*Mystus seenghala* (Sykes)

Raj (1940) infers from his observations that the breeding habits of this species is similar to that of *M. aor*.

*Gagata cenia* (Ham. Buch.)

Day (1878) refers to some small specimens he examined from Darjeeling.

**Clariidae.**

Very little is known about the breeding habits and early development of fishes belonging to this family.

*Clarias teysmannii* (Bleeker)

Deraniyagala (1930-32) describes the colour of the eggs and records the dates of collection of ovigerous females in Ceylon.

**Heteropneustidae.***Heteropneustes fossilis* (Bloch)

Day (1878) describes the ova from an ovigerous female captured at Bezvada. According to Deraniyagala (1930-32) this form spawns all the year round.

**Sisoridae***Sisor rhabdophorus* (Ham. Buch.)

Day (1889) says that the young of this has the habit of remaining under stones.

(To be continued.)

## NOTES ON THE INDIAN MAHSEERS.

BY

K. DE B. CODRINGTON.

In Vol. xli (Nos. 2, 3 and 4) and Vol. xlii (No. 1.) of the *Journal of the Bombay Natural History Society*, Dr. Sunder Lal Hora continues his researches upon the Indian Mahseers. In his prefatory papers in Vol. xxxix of the same *Journal*, he confesses that 'the precise generic and specific limits of the forms included under this composite term' are not easy to define. He also stresses the want of field observations, especially from anglers. The following notes are based upon plentiful catches recently made in the Ghorband, Kurram, Swat, Jhelum, Chenab, Sutlej and Kistna rivers, and in certain of the Indian lakes and other enclosed waters. Although I have collected fish elsewhere, I must confess that I found the preservation and transportation of specimens of Mahseer impossible under war-time Indian conditions. I suggest that it would be profitable to issue simple directions for dissection to collectors, so that information as to the condition of the ovaries could be recorded photographically.

### 1. *Nomenclature.*

Dr. Hora recapitulates the current explanations of the name Mahseer, and in doing so quite rightly disposes of a good deal of bad etymology. Dr. Chhabra's rejection of the derivation from Persian Mahisher is interesting; he points out that the Persian compound should properly be Shermahi. One of the common Barbels of Afghanistan, of which I sent specimens to Dr. Hora from both sides of Hindu Kush, is actually known as Shirmahi, but it has neither a big head nor is it a lion-hearted fish. Dr. Hora makes it plain that many of the dialect names of the Mahseer refer to its big scales, but he might have added to the Bengali Mahasaul (Mahasalkalin) the common Marathi name Masla (Mahasala) which is corrupted into Kawli massa, 'the scale fish'. Again, in Afghanistan, the Mahseer is known in Persian as Mahipatra, which, also, means 'scale fish'. The fitness of the term is clear and it is not surprising that it is used from the Kistna to Bengal to Afghanistan. On the other hand the Tamil name Bom-min (Pon-min) identifies the Mahseer as 'the gold fish'.

### 2. *Area.*

The eastern limits of the Mahseer are extensive but vague. It certainly exists in Burma and friends of mine from Siam and the Philippines have professed to recognise Dr. Hora's excellent plates. However, leaving aside the known African species and possible Mesopotamian relations, the western boundary of the Indian Mahseer species is clearly defined. They exist in the Hub and other rivers in the neighbourhood of the Karachi coast. They

are found in the rivers of Baluchistan, Waziristan, in the Gomal and the Gumti and the Kurram, and I have caught specimens myself at Begram, near Charikar on the united Ghorband and Panjshir Rivers in Afghanistan, as well as in the Kunar (Chitral) River below Kila Drosh. Local fishermen at Begram, who are familiar with the Mahseer, though somewhat uncritical of its specific points, say that it does not run very far up the Ghorband and is not found at all in the Panjshir itself. It is not found, or recognised, in the Helmand river or in the tributaries of the Oxus system. It seems clear that the Hindu Kush-Kabul Kohistan watershed is its western limit in this region, as it is the eastern limit of the Oxus trout. With reference to trout in Asia, it is well worth noting that everywhere in India this fish is a western importation. The Kurram was stocked with trout from Kashmir; but it is perhaps also worth recording that H.R.H. Shah Ahmad Khan recently put some Oxus trout in a tank in his garden in Paghman near Kabul. With regard to the Kabul Valley, the Mahseer is not found in the Kabul River above the Tangi Garu falls, or in the Logar. Nor does it occur in any of the Kabul Kohistan streams, which are drained dry by irrigation canals and do not communicate with the Ghorband-Panjshir-Kabul system, except when in spate.

### 3. Migration.

The Mahseer is generally treated of as being a migratory fish, running up river to spawn. The suggestion that it does not run up the Ghorband much above Begram or up the Chitral River above Drosh, which I believe to be true, indicates an upper limit of migration of about 6,000 feet altitude for those latitudes. With regard to peninsular India 'Skene Dhu' (*The Angler in India*, 1923, p. 19.) records that it is not to be found in rivers rising below 1,000 feet above sea level. This suggested lower limit is probably too low, but I did not find the fish, or any knowledge of it, in the Manjira River system, a tributary of the Godavari in Hyderabad State. Moreover, the whole question of the altitude limits of tolerance of the Mahseer, and of its migratory nature, is complicated by the undoubted fact that in many parts of India, Mahseer are found in lakes and artificial tanks at varying altitudes. I have caught small Mahseer virtually at sea level in the Kolak River, north of Bombay, though I believe this river is open to upward migration to a fair altitude (1,300 ft. ?). On the other hand, many of the canals in Northern India have Mahseer in plenty, which cannot possibly migrate to higher spawning beds. Even where there are fish-ladders, I have never been able to convince myself that they are effectively used. This is a subject of some importance. These canal Mahseer undoubtedly develop normal ova, but until direct evidence of spawning is available, it should not be assumed that their spawn is viable. Fry in great numbers are washed through the upper canal head-works during the spring and summer floods, and these are quite sufficient in number to maintain a dense population. These semi-isolated fish may be compared with the Mahseer of such rivers as the Kistna, which during the

hot weather, are reduced to un-connected chains of pools. The great, high altitude lakes, such as the Kumaon Lakes or Bhandara-dara in the Ghats above Bombay, are clearly fertile breeding-grounds, but fresh observations are urgently needed with regard to the sacred fish preserved in small artificial tanks, such as that at Hassan Abdal near Rawal Pindi. It is difficult to see how these fish are propagated. I have never been able to find any evidence that such tanks are restocked.

The extant evidence may perhaps be summarised by saying that the upper altitude range of the Mahseer seems to be limited in terms of a minimum temperature. In other words, the Mahseer does not like cold which is the reason why, in December and January, they congregate in their hundreds at the head of the famous Jungoo Pool at Tangrot, near the Jhelum-Poonch junction, where there are warm springs. On the other hand, they flourish throughout the whole range of water temperatures normal to peninsular India.

Since taxonomy cannot be divorced from environmental considerations, it would seem advisable to pay special consideration to the lake, tank and canal types of Mahseer. On the other hand, it is quite clear that the Mahseers of the great rivers of the North of India are migratory, though the causes of the upstream and downstream movements are not yet intelligible. For one thing, it is assumed that the spawning grounds lie upstream. Analogies based upon the habits of the salmon are obviously unjust, but, remembering the critical altitude-temperature factors controlling the viability of trout spawn—the assumption may be accepted as an optimum tendency. On the other hand, direct observations of the spawning of the Mahseer are almost entirely wanting, and a certain conflict of evidence as to the times of migration and the seasonal development of the ovaries must be taken into consideration. Thomas (*The Rod in India*, p. 42.) put forward the theory that the Mahseer dropped its spawn by batches, repeating the process several times in the year. There does not seem to be any evidence for this, beyond the fact that Mahseer are caught in varying states of ovarian ripeness throughout the year. Recently Hamid Khan in Vol. xli of the *Journal of the Bombay Natural History Society*, has suggested that there are three distinct spawning seasons, (1) January and February, (2) May and June and (3) July to September, the monsoon flood months.

Sufficient evidence is obviously wanting, but after opening over a hundred well-grown fish caught in the Jhelum throughout the year, I can find no confirmation for a May-June breeding season. The state of the ovaries of fish caught at Tangrot in late November suggests a minor breeding season in January-February in those waters: while there is a good deal of evidence for what I take to be the major breeding season in August in the upper Jhelum and Wular Lake. The fishermen at Tangrot insist that there are no adult Mahseer there from late June to late September. I, myself, have fished at Tangrot in early June, when Jungoo was unpopulated and the junction Pool empty of big fish. I have followed the river downwards from Ningle on the Wular Lake, which I



found empty in the last week in June, to Domel and saw the first shoals (Punjabi, *Toli*) pass Rampur a week later. I have returned to Tangrot in the last week in September to see the first sizeable fish appear in the junction Pool and Jungoo. Moreover, I examined the higher pools of the Poonch on the same day as the first shoal showed in Jungoo, and found fish at Chak, six miles up, the intervening pools being empty. It would, therefore, seem to be true that the fish, which congregate in thousands at Tangrot during the cold weather, run up either the Poonch or the Jhelum in May and June and return in September.

#### 4. *Breeding in terms of Migration.*

It is important that the conditions of the normal cycle of movement should be examined. Fortunately in the cold weather until February, the Poonch at Tangrot is crystal clear, and its pools can be examined in detail, wherever the banks are high enough to enable one to look down. The fishermen say that the small fish are the first to arrive in September and the last to leave in June; and the Tangrot Fisherman's Records also suggest that this is so. In many places in the Jhelum above Domel, there are fish-jumps. I watched one of these, three miles below Rampur, in the first week in July, and saw hundreds of fish pass upwards. Before Kashmir State developed the timber trade, it seems that the fish arrived in these reaches much earlier, but now in June the river is a mass of floating logs, the effect of which can be seen in the scarred and battered fish caught at all seasons; one-eyed fish are noticeably common.

The upper Jhelum is, on the whole, a clear water river, the snow-water settling in the Wular basin. Snow-water floods occur on the Poonch from the end of February to the end of April. Rain floods begin in June, when the monsoon breaks, and continue until well into August. The water is then thickly coloured by the river's muddy tributaries, the Kunhar being especially turbid. Since the fish do not begin to move upstream until shortly before the rain-floods, it is difficult to see how there can be a summer spawning season, as Hamid Khan suggests. The mass of water and the speed of the current forbid it. By the end of August the river is clear and the water has fallen considerably. It continues to fall until the snow-floods start in the Spring. In May, between the snow-floods and the rain-floods the water again falls considerably. The available evidence seems to me to suggest that there are two breeding seasons on a migratory basis:—at low water in January and February in the lower Poonch at Tangrot; and in August in the Upper Jhelum and the Wular Lake.

It is important to realise that small Mahseer are to be caught in the lake at all times. The fishermen of Sopore catch them, illegally, on long lines, and I have seen them taken from the water in June, before the migratory fish arrive from the lower reaches. Furthermore, among the small fish to be caught at Tangrot in late May and September are large numbers of obviously juvenile fish. They are of slim proportions and have a pearly lustre, which is quite unlike the livery of the mature fish, and is indeed,

unmistakable. Although I have frequently caught small Mahseer of  $1\frac{1}{2}$  lbs with developed ova, these juvenile fish are all immature. In September they are seldom much over a pound in weight, but in June I have caught them up to 7 lbs with rudimentary ova. It is possible, therefore that the fish spawned in the early Spring at Tangrot do not migrate until they are yearlings. Unfortunately there is no evidence, for the summer flood months at Tangrot, when the floods forbid netting and the colour of the water makes rod-fishing impossible. But it is certainly true that the Mill Reach above Jungoo, where a little stream joins the Poonch, is plentifully supplied with infantile Mahseer, from 4 ins to 8 ins in length at all other times. I must, however, admit that I have never seen Mahseer fry in the upper Poonch or Jhelum, though I have thought I have identified them in the pellucid, colourful depths of the Wular Lake.

I have one further piece of evidence as to the migration of the Mahseer. On Christmas day, 1941, Major Roger Bacon, then Political Agent, Khyber, saw many large fish trying to pass the head-works of the Upper Swat Canal at Amandara. In the first week in February I myself saw the same thing. There were at least two dozen fish in the pool below the dam. Neither Major Bacon nor I were able to land one of these fish. It is worth noting that it is usually said that the Mahseer leave the upper Swat river in October and that its waters are empty till April. This is evidently not so. Indeed what Major Bacon and I saw, suggests a tendency to work up stream in early spring; and this tendency is probably instigated by the fact that the best breeding grounds lie up-stream.

##### 5. Taxonomy.

I can add very little to the discussion of the specific arrangement of the Indian Mahseers, except to point out that, from the point of view of behaviour, they are all of a kind. As a genus, they provide the fishermen with a single problem. Here a clear distinction must be drawn between the large mouthed *Barbus* species and the small mouthed. Fishing for Mahseer is altogether a different proposition from fishing for *Barbus jerdoni* or *Barbus dobsoni*. Of the Mahseers, two of the reported species seem to me to be well-established—the Bokar of the Assam rivers and the dark green, tubby fish of the Kistna. My notes on both these fishes show a remarkable consistency of colour, size, scale and fin count. I have too little experience of the Mahseers of South India to generalise, although I have had a certain number of them in my hands.

It is, perhaps, natural that the available descriptions should make much of the Mahseer's colouration. It certainly is very striking, but it must be confessed that it varies very considerably. Moreover, the colours of the living fish change rapidly after death, the reddish tones strengthening, while the jade green and blue tones pale to brown and slate. Thomas, with the living fish in front of him, describes the dominant Bawanny Mahseer as worthy of its name, Bom-Min, the gold fish. He says that its colour is not

really gold-fish-like but 'something between the colour of a bright new sovereign and that of bright, shining copper fresh from the mint, the burnished copper the colour of the outside of each scale, and the tinge of brighter gold flashing through the centre of each scale and coming out almost all over the gill covers and showing freely in parts of each fin'. He specifically says that this is the 'predominant colour of every scale'. I have seen these golden Mahseer in the Bawanny and accept Thomas' description. I have, also, seen his second type of Mahseer 'with grey back, silver stomach and bright orange fins and tail'. But I have never been fortunate enough to catch his third, with 'deep chocolate coloured back and fins, the colour blending into golden brown on the sides and gills and fading into white on the stomach' the eye being vermilion. 'Skene Dhu' quotes three Mahseers :—(1) the Punjab Mahseer which he describes as 'silvery with scales becoming golden below the lateral line and fins reddish', (2) 'The Mahseer of the Narbudda (in which river No. (1) is also to be caught)—Pale Blue', and (3) the jet black Mahseer of the Kalinadi River, which he also reports from the Punjab. His pale blue Mahseer from the Narbudda is common enough; I have, also, caught these fish at Rupar on the Sutlej. I have never seen a black Mahseer, though I have caught many that were either deep jade green or dark slate, and I have noticed that the green body colour usually goes with gold-red fins, the others having pinkish fins which rapidly redden after death.

Dr. Hora states categorically that the colouration of *Barbus (tor) putitora* 'varies considerably with the type of waters inhabited by it'. I think that this warning should be applied to all Mahseer species as, indeed, it does to trout and many other genera and species of fish. The most extreme example of colour variation I have found among Mahseer was a female fish of 27 lbs., which I caught in the Swat River, in the sandy pool above the head-works of the Upper Swat Canal. It was an opaque white, exactly the colour of the river bed. This was an old fish, which may account for the want of silvery tones, but the conformity with the background was most striking. Fish of this size are not washed over the dams even in floods, and as I have never seen the fish-ladder at this particular head-works used, upwards or downwards, I am inclined to think this fish had inhabited the pool for some considerable time.

With regard to the precise identification of the Mahseer species of the rivers of North India, any fisherman with sufficient experience will, I think, agree as to the existence of the two acknowledged species, *Barbus (tor) putitora*, and *Barbus (tor)*, Tor of Hamilton. The former is a long, racy fish, with a big mouth and a long head; the latter a shorter, heavier fish, with a smaller mouth and a shorter head. On the other hand, I admit that I cannot distinguish Hamilton's *Barbus (tor)* moral from his *putitora*. As I have said, I feel that until a larger number of living fish have been described, little weight should be given to differences of colouration in distinguishing Mahseer species as a whole. My first impression is that the Mahseer of the Kurram, Ghorband and Kunhar Rivers are of the *Putitora* type. But this

does not amount to more than my second impression, that the Putitor inhabits faster water than the Tor Mahseer, and is therefore found higher up the rivers.

#### 6. Sex and Size.

Dr. Hora (*Journ., B.N.H.S.*, Vol. xli, pp. 278 *et seq.*) admits that the formation of the lips of the *Barbus (tor) putitora* varies considerably, and says that this wide variation is common to the Mahseer species of India, as well as to 'the large scaled Barbel of the neighbouring countries and Africa'. Thomas rightly observes that it is found in small immature Mahseer and rebuts the almost universal opinion of Indian fishermen that the Mahseer with hypertrophied lips are females. Ghulam Muhammad, the chief shikari of Tangrot, is the only Indian fisherman I have ever met who knew this to be false. My own observation of sex differentiation are limited, but my experience indicates that the females greatly exceed males in number. I have only found three male Mahseer. All these were well under 7 lb. and were long, thin fish, noticeably less in girth than the females from the same waters. I am convinced that the bulk of large Mahseer of over 20 lbs. are female. I can find only one case of an alleged large cock fish in the Tangrot Fisherman's Books. This weighed 53 lbs. and was caught in the Jungoo Pool; no details of the dissection are given, and knowing the difficulties of field dissection, the entry may be considered dubious. I must, incidentally, record that I have never caught a Mahseer with hypertrophied lips of over 15 lbs.

I have never preserved, or attempted to analyse, the scales of the fish I have caught. But, as I have already suggested, there is a great difference between the lustre of the average fish between three and twenty pounds and large fish of over twenty-five pounds. Most fish of over twenty-five pounds suggest senility, rather than maturity, and this is clearly indicated by the size and condition of the female organs.

It is possible to get a fairly accurate idea of the range of size of the living Mahseer, by climbing the hill above the Jungoo pool at Tangrot. In November and December, the head of the great pool is thick with fish, lying head to tail. Immediately below the neck of the pool, where the warm springs are, lie the monsters. There are usually four or five fish of well over sixty pounds. At that time, the water is crystal clear and at midday every movement of tail and fins can be seen from above. The monsters hardly stir. Then come, rank after rank, the lesser fish. Occasionally a small fish noses its way into the high places of the great, only to scurry to the safer shallows at the first movement of a fin. At the tail of the pool, fish of up to 10 lbs cruise about, the smaller ones obviously feeding on the bottom or among the mixed fry near the banks. It is interesting to notice that several fish of fifty two or three pounds have been caught at Tangrot, but none bigger. The monsters of Jungoo do not take any known bait, and the fact that even live bait will not move them, suggests that in old age the Mahseer becomes wholly a bottom-feeder. I have often noticed how bad the throat-teeth of the average Mahseer of over ten pounds are,

though this is probably not the reason why they turn away from the cannable delights of their maturity. There are many pools such as Jungoo is, throughout the length and breadth of India. I have watched the fish in them for hours throughout daylight, but I have never seen the really big fish feed.

The infantile Mahseer, like the mature Mahseer, is omnivorous. But they have their seasons and close-seasons. In October in the Chiblat River at Hassan Abdal, the weed grows thick and luscious, and the Mahseer, also, grow fat on it, refusing all other bait, except a live frog, the one bait which may tempt Mahseer at all times of the year. I have, also, noticed that the stomachs of the fresh run fish, arriving in Jungoo from upstream after the autumn downward migration, are usually empty except for masses of *convervae*. But they will take minnow, live, dead or artificial, if it is offered to them sufficiently skilfully. The explanation seems to be that they are too tired for the first few days to face the rapids, near the banks of which the fry and small fish nervously hide. Fry are on the whole strikingly absent from such pools as Jungoo and in September-October there is nothing much else edible in them, except *convervae*. A few days later the fish move out into the rapids, and the Fisherman's Books and all who know Tangrot, agree that October is the river's best month, challenged only by March. On the other hand it is hard to believe that the monsters live only on *convervae*. Molluscs are not universally distributed in such pools, or indeed, in any Indian river. I am inclined to think that worms form a larger part of the Mahseer diet than is usually admitted. I, also, have incontestable evidence that he does not spurn the dropping of the herds that go down to drink in the evening.

The Tangrot Fisherman's Books are full of references to 'the Chilwa running' and laments of 'no Chilwa'. I have never caught or seen *Chela argentea* in the Jhelum or Poonch. There are plenty of silvery Tengra (*Macrones seengala*) though they seem to run rather small; at least, I have never caught one of over 2 lbs. At the head of Jungoo, there are, also, usually one or two large *Wallago attu*. There are, also, a few Kalabans (*Labeo calabasu*). Unlike the Tengra the Labcos are unprotected by spines, and they have no teeth like the fresh-water shark; it is evident that the Mahseer rules the roost in the lower Poonch and Jhelum. The population pressure is set up by the Mahseer, itself, and, since he is essentially a cannibal, he probably also is its most important limiting agent.

If the opportunity ever comes my way again, I shall certainly devote as much time as possible to taking the census of pools like Jungoo. As everywhere, it is certain that the size and numbers of the fish are directly governed by the size of the waters and the richness of the feeding grounds. A big fish from the Chiblat would be inconsiderable by Tangrot standards. Moreover, all these Indian rivers have suffered at the hands of man. They have all, at times, been dynamited and are all netted and long-lined in spite of regulations and paid watchers. At Tangrot the recorded weights of fish caught do not provide a smooth curve. Fish up to 15 lbs. are frequent and those of 25 lbs. are not infrequent. More-

over, fish of over 35 lbs. are surprisingly common. But in between there seems to be a gap. My own records and observations of the population of Jungoo agree with this, though I cannot account for it. It would be interesting to find out if the larger Jhelum fish migrate upstream to the Woolar Lake, a gruelling journey which would cause heavy casualties. It is possible that the monsters spawn in the lower tributaries of the Poonch, each having its fixed territory, so obviating the dangerous struggle upstream. I have never seen very large fish at the Jhelum fish-jumps during the actual migration, though it is common knowledge that fish of over 50 lbs. are to be caught at Ningle in August.

### A NOTE ON SOME SNAKES OF BENARES (U.P.)<sup>1</sup>

BY

M. N. ACHARJI, M.SC.

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The 'Kaiser Castle'<sup>2</sup> at Benares, which at present houses the office and collections of the Zoological Survey of India, consists of blocks of buildings in a large compound situated on the bank of the Varuna river. Specimens of snakes occasionally found in the compound or inside the rooms of the 'Kaiser Castle' have been collected by some members of the staff during the last three years. The collection at present consists of 17 specimens belonging to 5 species.

The collection at my disposal is far too small to give any idea of the number of species of snakes occurring in and around Benares, but as practically nothing is known of the snake fauna of this area, a record of the species already collected will, it is hoped, prove useful. Except for one paper by Wall<sup>3</sup> on the snakes of the Fyzabad district, I am not aware of any works dealing with the reptilian fauna of the United Provinces specially. During the course of 19 months active collection at Fyzabad, Wall was able to collect 704 specimens referable to 18 different species.

Fauna as a whole in Benares is very poor. Nevill<sup>4</sup> has remarked: 'The density of population, the high state of agricultural development and the absence of forests or extensive jungles combine to render Benares one of the poorest districts in the matter of wild animals of all those that are comprised in United Provinces.'

I am grateful to Dr. B. N. Chopra, Director, Zoological Survey of India, for going through the manuscript and making some helpful suggestions, which, I feel, have materially improved

<sup>1</sup> Published with the permission of the Director, Zoological Survey of India.

<sup>2</sup> Named after the owner H. E. Sir Kaiser Shumshere Jung Bahadur, Rana of Nepal.

<sup>3</sup> Wall, F., *Journ., Bombay Nat. Hist. Soc.*, xviii, pp. 101-129 (1907).

<sup>4</sup> Nevill, H. R., *Gazetteer of Benares*, xxvi, pp. 17-18 (1909).

this note. I am also thankful to those members of the staff of the Zoological Survey, who have collected the specimens on which this note is based.

The following 5 species are represented in the collection:

FAMILY: COLUBRIDAE.

1. *Ptyas mucosus* (Linn.): 8 specimens; collected in March, July, September, October and November.
2. *Oligodon arnensis* (Shaw): 2 specimens; collected in March, and April.
3. *Lycodon a. aulicus* (Linn.): 4 specimens; collected in June, July and September.
4. *Natrix piscator* (Schneider): 1 specimen; collected in June.

FAMILY ELAPIDAE.

5. *Naja n. naja* (Linn.): 2 specimens; collected in April and June.

***Ptyas mucosus* (Linn.)**

(The Rat Snake or Dhaman)

1758. *Coluber mucosus*, Linn, *Syst. Nat.*, Ed. 10, p. 226.

1864. *Pyas mucosus*, Gunther, *Rept. Brit. India*, p. 249.

1943. *Ptyas mucosus*, Smith, *Fauna Brit. India*. (Reptilia & Amphibia), iii, p. 159.

There are 8 specimens in the collection, varying in length between 413-1670 mm.

Wall (*loc. cit.*, 1907, p. 114) has remarked on the variation in the range of ventrals and subcaudals in this species and has pointed out that in the Fyzabad specimens there is a tendency for the subcaudals to be fewer in number than in the examples he had previously examined from Cannanore. The same is also observed in the 8 specimens from Benares that I have examined, as is seen in the accompanying table.

Comparative Table of Scale Counts.

				Ventrals		Subcaudals
Fyzabad collection	...	...	(8) <sup>1</sup>	♂	192-207	100-126
			(8)	♀	191-206	108-115
Benares	„	...	(8)		192-209	102-124
Cannanore	„	...	(4)	♂	197-202	127-137
			(3)	♀	192-196	128-132

According to Smith the range in the number of the ventrals and the subcaudals is as follows:

Ventrals 190-213; Subcaudals 100-146. Wall and Pope<sup>2</sup> have stated that the males are greater in length than the females.

*Ptyas mucosus* is found throughout India and Indo-China. It has also been recorded from Java and Sumatra.

<sup>1</sup> The figures in parentheses show the number of specimens on which the scale counts are based.

<sup>2</sup> Pope, C. H., *The Reptiles of China*, x, p. 221 (1935).



**Oligodon arnensis (Shaw)**

(The Common Kurki Snake.)

1802. *Coluber arnensis*, Shaw, *Gen. Zool.* iii, p. 526 (based on Russell's fig. 38).

1890. *Simotes arnensis*, Boulenger, *Fauna Brit. India*. (Rept. & Batrachia), p. 314.

1943. *Oligodon arnensis*, Smith, *Fauna Brit. India*. (Rept. & Amphibia), iii, p. 225.

*Oligodon arnensis* is represented in the collection by two juvenile specimens, measuring 185 and 175 mm. respectively.

The larger specimen has 32 black bars on the body and 12 on the tail, while the smaller one has 34 bars on the body and 10 on the tail. The broadest black bars occupy 3 scales. They are narrower on the sides, have white margins and do not reach the ventrals.

Wall<sup>1</sup> has noted that specimens from the United Provinces, Punjab, N.W. Frontier and Western Himalayas have 41-54 black bars on the body and 9-12 on the tail, while one specimen from Orissa had 37 bars on the body and 6 on the tail.

Smith after examining a series of specimens from different localities came to the conclusion that the number of black bars on the body and the tail is roughly correlated with the geographical distribution of the species. He arranged them as follows:

Ceylon, 13-18 on the body, 3-6 on the tail.

India, South of lat. 20° 18-30 on the body, 4-16 on the tail.

India, North of lat. 20° 7-20 on the body, 7-20 on the tail.

In both the specimens from Benares the loreal scale is present. According to Smith this scale is usually present in specimens north of lat. 20°, but absent in examples south of that line. Wall (*loc. cit.*, 1914, p. 755) has also remarked that the loreal is rarely absent in examples from Fyzabad.

*Oligodon arnensis* is very widely distributed, and is one of the common forms found in the United Provinces. According to Smith its habits are chiefly diurnal, and it appears to make its home for the most part in masonry, domiciling itself in bungalows and out-houses.

**Lycodon aulicus aulicus (Linn.)**

(The Common Wolf Snake.)

1758. *Coluber aulicus*, Linn., *Syst. Nat.*, 10th Ed., p. 220.

1876. *Lycodon aulicus*, Stoliczka, *Journ., Asiat. Soc. Bengal*, xxxix, p. 201.

1943. *Lycodon a. aulicus*, Smith, *Fauna Brit. India* (Rept. & Amph.), iii, p. 265.

There are four examples of *Lycodon a. aulicus* in the collection varying in total length between 450-540 mm. Wall<sup>2</sup> gives the total length of the largest male and female of this species, so far recorded, as 692 and 737 mm. respectively.

In every specimen there are 8 upper labials, of which the 3rd, 4th and 5th, touch the eye. There is absence of brown spots on the upper labials of one specimen (collected in Sept. 1942), while the rest have faint brown spots.

In all the 35 examples in the Fyzabad collection examined by Wall (*loc. cit.*, 1907, p. 113), the anal scale was found to be divided. In my collection from Benares there is one specimen in which this scale is entire. This aberration has been recorded by Smith (*loc. cit.*, 1943, p. 255) in several species of *Lycodon*, such as *aulicus*, *striatus*, and *travancoricus*.

The colouration of all the four specimens is of the same type, but the number of cross bars on the dorsal surface varies considerably. One example

<sup>1</sup> Wall, F., *Journ., Bombay Nat. Hist. Soc.*, xxii, p. 751 (1914).

<sup>2</sup> Wall, F., *Ophidia Taprobanica*, p. 159 (1921).

has 19 cross bars, one 15, one 18 and the remaining one 10. In every case these bars are whitish with faint brown spots.

Smith<sup>1</sup> has described the arboreal habit of *Lycodon aulicus*, stating 'It is a good climber and appears to prefer the roof to the floor'.

### *Natrix piscator piscator* (Schneider.)

(The Chequered Water Snake.)

1799. *Hydrus piscator*, Schneider, *Hist. Amph.*, i, p. 247.

1940. *Natrix p. piscator*, Smith, *Rec. Ind. Mus.*, xlii, p. 483.

1943. *Natrix p. piscator*, Smith, *Fauna Brit. India* (Rept. & Amph.), iii, p. 295.

Four fairly well defined races of this species are recognizable, dependent chiefly on the colour pattern and geographical distribution.

According to Smith the following races are found in India:

1. *Natrix piscator piscator*.
2. *Natrix piscator flavipunctata*.
3. *Natrix piscator asperimus*.
4. *Natrix piscator melanostus*.

There are blackish spots on the dorsal surface giving off a bluish sheen. The spots are arranged in a 'Chess-board pattern'. The under-surface is whitish. The scale counts and the length of the single specimen in my collection are given below:

Scale counts: Mid-body 19; Ventrals 138; Caudals 78.

Total length: 976 mm. Tail 269 mm.

*Natrix piscator* chiefly feeds on frogs and fish. It causes great destruction to fish, when they are herded into shallow water at the end of the dry season.

### *Naja naja naja* (Linn.)

(The Indian Cobra.)

1758. *Coluber naja*, Linn., *Syst. Nat.*, 10th Ed., p. 221.

1943. *Naja n. naja*, Smith, *Fauna Brit. India* (Rept. & Amph.), iii, p. 431.

The most striking point of interest in the present species is the variation in the colour scheme and in the markings of the hood. Smith on the basis of the 'hood design' divided 'Indian cobras' (*Naja naja*) in three races, which can be correlated to some extent with geographical distribution also. Bannerman & Pocha<sup>2</sup>, after examining a series of specimens, had come to the same conclusion many years earlier. Wall found 12 different designs or patterns of the hood markings in his 39 examples from Fyzabad.<sup>3</sup> Out of the two specimens under report, the hood markings are distinct in one and tally with the markings shown by Wall on Plate I, fig. 4. In the second example the markings are interrupted and broken on the sides.

The colouration is brown in one specimen and blackish brown in the other. The total length of the specimens is 870 and 780 mm. respectively.

<sup>1</sup> Smith, M.A., *Journ., Nat. Hist. Soc., Siam*, i, p. 16 (1914).

<sup>2</sup> Bannerman, W. B. & Pocha, J. B., *Journ., Bombay Nat. Hist. Soc.*, xvi, p. 638 (1905).

<sup>3</sup> There are beautiful plates in black-and-white drawn by Wall (*Journ., Bombay Nat. Hist. Soc.*, xviii, pl. I & II, 1907) showing different hood patterns found in Fyzabad specimens.

# THE HEMIPENIS IN REPTILES.

BY

CHARLES McCANN, F.L.S.

(With 10 plates and 4 text-figures.)

## INTRODUCTION.

On going through the *Fauna of British India* (23) (Reptilia), 2nd ed., vol. iii (Snakes), we find several descriptions and seven illustrations of the hemipenes of snakes. These descriptions and illustrations have been largely based on material dissected out of spirit specimens, and, consequently merely give a picture of the organs in a quiescent state, retracted into the base of the tail. Such descriptions and illustrations, though valuable in themselves, can give no idea of the organs in the everted condition, which is perhaps the truer aspect. The study of the everted organ may possibly throw some light on the habits, anatomy, and other features of the various species. It is already well-known that there is a considerable variation in the structure of the hemipenis from genus to genus, and in some instances from species to species. Although some herpetologists have attempted a classification based mainly on the morphology of these structures, there appears to be plenty of room for further investigation based on especially collected material.

Col. Frank Wall (13), that indefatigable field-worker on Indian snakes, was apparently the first to draw attention to the subject of the possibility of a classification based on the structure of the hemipenis. In 1923 when reviewing the genus *Oligodon* in the *Records of the Indian Museum*, Wall wrote:

'A study of the genitalia shows that there are very different varieties to be met with among the species, and it is possible the genus, as now represented, may be divided hereafter on this basis.

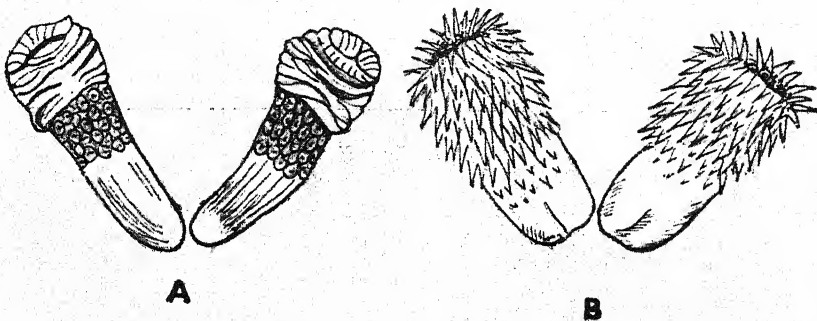


Fig. 1, Hemipenes of A. *Oligodon albocinctus*; B. *O. sublineatus* (after Wall.)

'However I have the genitalia of only four species, it is wisest provisionally to let them all remain under the one generic title *Oligodon*.' (l.c., p. 305.)

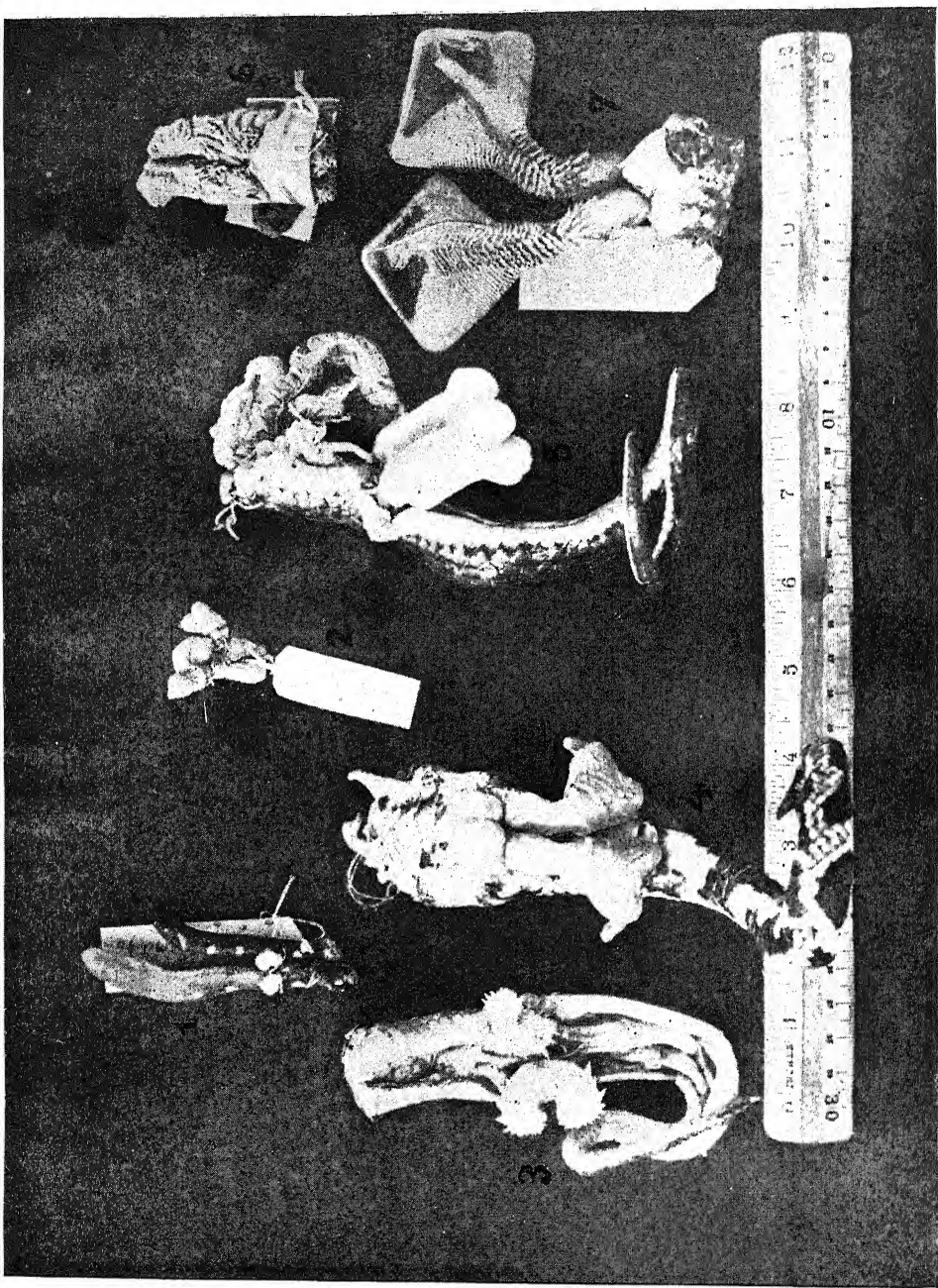


Photo:

### Hemipenes of Snakes.

1. *Hydrophis cyanocinctus* (Daudin); 2. *Bungarus caeruleus* (Schnd.); 3. *Vipera russelli* (Slaw); 4. *Python molurus* (Linn.); 5. *Natrix piscator* (Schnd.); 6. *Pylas mucosus* Günther, (partially protruded); 7. *P. mucosus* (fully everted).

C. McCANN.



'The male genitalia vary in the species here included in one genus, and it is possible that this variation may be used as a basis for a subdivision of the genus into two. I have dried genitalia of four species in my collection. In *taeniolatus* and *sublineatus* the organ is relatively small, cylindrical and beset with recurved cartilaginous processes from base to extremity, just as one sees in so many other species of the *Colubridae*. In *albocinctus* and *juglandifer*, however, the organ is relatively very large, cylindrical, and increases in girth from base to extremity, being cleft at the extreme tip. There are no recurved processes. The proximal third has feeble longitudinal rugae, the middle third a honey-comb network, and the distal third concentric and somewhat imbricate rugae (see figures)' (*l.c.*, p. 306.)

Although Wall saw the possibility of a classification of snakes based on the structure of the hemipenis, he evidently did not pursue the subject further for I can find nothing more from his pen relative to it. Wall had only dried genitalia of four species and describes 'two forms' in his paper referred to above. The illustrations of the two types, fig. 1, show clearly the differences, although the organs are not fully everted. Here we must leave Col. Wall and pass on to a decade later.

In 1933 C. H. and S. H. Pope (17), undertook a study of the Asiatic and Malasian Green Pit-Vipers identified under the name *Trimeresurus gramineus* and published their results in the *American Museum Novitates*. Their investigations were based entirely (?) on preserved material dissected out from specimens in the collections of the British Museum (Natural History) and those in the American Museum of Natural History. The results indicate that

'A study of the hemipenis of nearly every valid species of *Trimeresurus* has convinced us that this genus may be divided into groups of allied forms having different types of hemipenes.' (*l.c.*, p. 1.)

The authors were conscious of the possibilities arising out of this method of classification for they asked the question:

'... is the hemipenis more or less stable than the various external characters generally relied upon for the determination of the species and even genera? Also, is it more valuable for the separation of large or small groups, in the classification of snakes? In the genus *Trimeresurus*, the hemipenis is excellent for the separation of the various species into groups, but we think it would be dangerous to generalize until more detailed data on this organ in other genera are available.' (*l.c.*, p. 3.)

However, a serious difficulty with this form of classification is undoubtedly the determination of the females. The authors, quoted above, refer to this aspect in their conclusion which reads:

'The females of *T. gramineus* and *T. stejnegeri* cannot be distinguished from each other with certainty, while mature males are recognised at once by the form of the hemipenis. Immature males generally may be separated by colour characters. The meaning of this similarity in two form with radically different hemipenes is not understood but may be correlated with ecological adaptations therefore field studies are much needed.' (*l.c.*, p. 12.)

The frequent handling and observing of living snakes and lizards first drew my attention to the subject of the hemipenis on account of the frequent eversion of the organ when handled. This behaviour led me to consider the subject of copulation in many of

its aspects in these two groups of reptiles. With a view to understand the true characters and function of the organ, I adopted a simple process of everting the organ when in the fresh condition, and of fixing it in the everted condition in preservation. This method, which I shall explain below, can only be applied to fresh material, i.e. recently killed animals. The photographs and diagrams will fully illustrate the points I have raised. Before proceeding, however, it is necessary to give a brief explanation of the structure of the organ without delving too deeply into its anatomical details and myology, and to refer to the postures assumed during coitus, which, I am of opinion, have a very significant bearing on the subject. Unfortunately, I have very little literature at my disposal and must therefore rely largely on my own observations.

A discussion on the structure of the hemipenis in snakes and lizards would perhaps be incomplete without reviewing the structure of the male genitalia throughout the Order. Accordingly, I will discuss the structure of the corresponding organs of crocodiles and chelonians by way of comparison.

#### STRUCTURE OF THE HEMIPENIS.

To start with, allow me to quote the definitions given in some of the standard text-books:

*Parker & Haswell* (7): 'A pair of vascular eversible copulatory sacs which when everted are seen to be of cylindrical form with a dilated and bifid apex, open into the posterior part of the cloaca.'

*Sedgwick* (4): 'There are two penes. They have the form of eversible hollow sacs opening into the posterior wall of the cloaca and attached by a retractor muscle, passing from the hinder end, to some of the caudal vertebrae. A groove runs to them from the opening of the vas deferens for the conveyance of the sperm. Erectile tissue is found in their walls. The organs can be everted through the anus and used as copulatory organs. They are present in both sexes, though less developed in the female.'

*Smith* (23): '... have paired copulatory organs. ... Each organ consists of a tube of erectile tissue, which can be everted like the finger of a glove. ... They are flattened on their inner sides, more rounded externally.' (l.c. p. 10.)

The above statements are but general descriptions which give us very little idea of the true structure and appearance of the organ, and therefore, need a certain amount of explanation to ensure clarity, as the characters vary much from the quiescent to the active condition.

Gadow's (3) descriptions of the organs in the various groups are in more detail; they read as follows:

*Lizards*: 'The cloaca of Sauria is somewhat modified; instead of the Coprodaeum, Urodaeum, and Proctodaeum forming three successive chambers, the urodaeum is practically reduced to its dorsal half, forming a dorsal recess between the two chambers. The Coprodaeum is restricted into several successive chambers, and is always well shut off from the urodaeum by a strong sphincter. The urodaeum receives the urinary secretions, which are mostly chalky, white and are rather consistant instead of being fluid. The right and left oviducts also open into it. The vas deferentia open into the dorso-lateral portions of the walls of the urodaeum; but the sperma is conducted by folds in the lining of the chamber towards the base of the copulatory organs, which,



although arising from the lateral and posterior corners of the cloaca, where uro- and procto-daeum meet, are stowed away outside the cloaca. These organs are always paired. The proctodaeum or outermost cloacal chamber is shallow. Its inner opening is round and is furnished with a strong sphincter, but it is surrounded and covered by lips of the outer skin, which forms a transverse slit. This is due to the peculiar arrangement of the copulatory organs.

Each organ consists of a tube of erectile tissue, and can be everted like the finger of a glove. To the apex of the tube is attached a long retractor muscle, which arises from the ventro-lateral surfaces of the caudal vertebrae and extends a considerable distance back. When at rest and withdrawn the organs form conical, longitudinal swellings on each side of the root of the tail, an external feature by which male specimens can generally be distinguished. Only one organ is inserted at one time.' (pp. 498-499.)

*Snakes*: 'The cloacal arrangement is essentially the same as that of the Lacertilia, but snakes possess no urinary bladder. The copulatory organs are stowed away beneath the skin in recesses of the posterior lateral corners of the shallow cloacal vestibulum. Each organ is usually bifurcated at the free end, and furnished with little spike-shaped, but scarcely horny, excrescences. On each side of the outer cloacal chamber, in both sexes, lies a roundish gland with an offensive, strongly-scented secretion; that of various Boas smells disagreeably sweet and musky.' (p. 585.)

T. Rymer Jones's (1) remarks on the structure of the hemipenis are of special interest, they are as follows:

'(2025.) . . . The earliest appearance of the copulatory organs is seen in Serpentes and in the Lizard tribes; and in such reptiles it will be observed that the penis is rather a provision for securing the juxtaposition of the sexual apertures of the male and female than an instrument of intromission. The two lateral halves of the penis (or *corpora cavernosa*, as we shall have to call them hereafter, when they become conjoined in the mesial line) are as yet quite separate, and palced at each side of the cloaca fissure, from which they protrude when in a state of erection, so that there appear to be two distinct organs of excitement, or, more properly speaking, of prehension: for each division, being of course imperforate, is covered with sharp spines, and is obviously rather adapted to take firm hold of the cloaca of the female than to form a channel for the introduction of the seminal fluid.' (l.c., p. 758.)

The organ is paired. When at rest the two halves are retracted *outside in* into the base of the tail. On dissection of the tail the operator *only* sees the *inner* surface of the organ. In this position it appears like two subcylindric, linear, muscle processes lying adjacent to one another. The organ is scarcely separable from the retractor muscle itself, except for a slight difference in colour, and texture on palpation. The retractor muscles extend the whole length of the tail. Nothing of the formation of the sculpturing is visible. On opening one of these bodies the operator sees what would be presented externally in the everted condition, but much shrunken and distorted, and therefore, he does not get a true picture of the external morphology of the organ. From this aspect of the organ we must pass to the everted aspect to understand its characteristics. As the two halves are exactly alike a description of one half will suffice.

Broadly speaking, half the organ, when everted, presents the shape of a flower bud with a short or long stalk. To facilitate description I shall refer to the stalk as the *pedicil* and the 'bud' as the *head*. The division between the pedicil and the head may be well demarcated or barely so. The pedicil may be strongly or

feebly armed with spines or excrescences of varying size and shape, or with fleshy transverse collars, flounces or ridges. Likewise the surface of the head may be beset with similar structures; or, both regions may be smooth or with just a few fissures or furrows. The head may also possess horn-like appendages. On the inner face (the side facing the central long axis of the body) there is a deep or shallow groove. This groove, known as the *sulcus*, may be clearly visible up the entire length of the organ or it may be less pronounced in the region of the head itself. This groove is in direct communication with the opening of the ureter, and acts as a channel for the conveyance of the spermatic fluid. (A few ridges run from the base of the opening of the ureter to the base of the *sulcus*.)

The bulk of the tissue composing the organ is erectile tissue, and when everted the organ is hollow within, except for the muscle strands drawn up from the retractor muscle and the semi-cartilaginous 'ribs' supporting it which are only visible in certain species. I shall refer to these structures under the specific heads of the species I have so far examined. The position of the organ at rest is often visible externally. It is represented by a thickened area just below the vent, but certainly does not always form an infallible distinguishing character between the sexes without further investigation. In practiced hands an animal can, many a time, be made to evert the hemipenis on pressure at a point a short way below the vent. It may evert only one or both halves simultaneously. To attain the extrusion of both halves together (which is sometimes possible) pressure must be exerted at a particular point. This must be located by practice. Merely lifting up an animal by its tail may occasionally produce the same result.

On going through the *Fauna* (23) we find the statement: 'In pairing, only one organ is everted at a time, but which one is immaterial, and depends upon the side the male happens to be at the time of copulation.' Gadow (3) makes a similar statement. On what grounds the "observation" or "conclusion" rests I am unable to say, but it certainly gives rise to much room for doubt when we consider the structure and behaviour of the hemipenis in the living animal. A significant point is the posture assumed during coitus. There is hardly any possibility, if at all, of observing the insertion or extraction of the organ for:

(a) the organ is only everted when the two vents are approximated;

(b) the organ is collapsed soon after the emission of the seminal fluid and the cessation of sexual excitement, and accordingly it is retracted at the time when the two vents separate.

With these two serious difficulties in view, actual observation is almost, if not entirely, impossible. I have frequently observed lizards in coitus, but have never been able to establish whether one or both halves of the organ are inserted for the reasons stated above. Even if a pair of lizards or snakes in coitus were killed instantaneously, the killing of the animals would result in the immediate cessation of sexual excitement, and would probably be followed by the partial or complete collapse of the hemipenis.

Again, under normal circumstances there is the possibility that one hemipenis may retract completely in advance of the other, and the partially retracted one may be 'trailed' in a flaccid condition for a while outside the vent. Such a 'trailing' of the penis after coitus is not infrequently observed among anserine birds. Injury to the organ during coitus may also result in belated retraction. This last point I have occasionally observed in *Calotes*. Perhaps the accidental extrusion of the hemipenis on such an occasion may have given rise to the statement quoted above.

### Testudines.

*Testudines*.—The formation of the penis in tortoises and turtles has been described in the *Fauna* (15) along with that of crocodiles. It reads as follows:

'In crocodilians and chelonians a median unpaired penis arises from the ventral wall of the proctodaeum and is extruded through the anterior end of the cloacal slit. On its dorsal surface there is a deep groove which leads back to the openings of the seminal ducts.' (*l.c.*, p. 29)

On p. 54 there is a little more detail:

'The cloaca is large and its divisions are imperfectly defined. The proctodaeum contains the unpaired copulatory organ, which is deeply grooved on its dorsal surface and is constructed much like that of the Crocodilia. The coprodaeum and urodaeum are confluent, and into them open the genital ducts, the bladder and the end of the gut, the termination of the latter being well marked.'

<sup>1</sup> T. Rymer Jones (1), writes:

'(2026.) In Chelonian reptiles the penis is much more perfectly developed, and really constitutes a very efficient intromittent instrument. The two corpora cavernosa, after commencing separately, approach each other, and become united along the mesial line so as to form a single organ of considerable size, terminated at its extremity by a glans-like dilatation. There is, however, no *corpus spongiosum*, nor urethral canal properly so called; the latter is represented by a deep groove which runs along the upper surface of the penis from the cloaca to the extremity of the organ; and it is along this groove that the spermatic fluid is conveyed during coitus.' (*l.c.*, p. 758.)

So far I have not had the opportunity of examining the genitalia of a freshly killed male specimen.

### Crocodilia.

The description of the penis cannot be dismissed in general terms in the *Crocodilia* as it is rather a complex structure. This statement is all the more forcible when it is viewed from the aspects of comparative anatomy and field observations. Gadow (3) describes it in the following terms:

'In the latter (proctodaeum) is stowed away the large copulatory organ. It arises out of the medio-ventral wall of the cloaca, and has a deep, longitudinal groove on its morphologically dorsal side for the conduction of the sperma, the vas deferentia opening near its basal end. On either side of the root of this organ, in both sexes alike, opens a peritoneal canal, wide enough in large specimens to pass a goose-quill. The outer opening of the cloaca forms a longitudinal slit: within it dorso-laterally, are the openings of the two anal musk glands.'

The *Fauna* (15) states:

'On its dorsal surface there is a deep groove which leads back to the openings of the seminal ducts.'

<sup>1</sup> T. Rymer Jones (1), writes:

'(2029.) In the Crocodiles and higher Saurians the penis in its structure resembles that of the tortoise; and instead of a urethra, there is merely a deep groove traversing the upper surface of the organ, along which the semen trickles out of the cloaca.' (*l.c.*, p. 758.)

To the field-worker the position of the sulcus offers some difficulties which I shall indicate below, after describing the organ. For the purpose of clarity I shall refer to it (the sulcus) as being ventrally situated.

**Crocodilus palustris** Lesson. (Pl. III & Pl. V) & Text-fig. 2.

The penis is composed of solid fibrous tissue and consequently cannot alter its size and shape when under the stimulus of sexual excitement. The rigidity of the organ, however, is compensated for by the presence of erectile tissue at its base which is capable of altering the position of the penis from the retracted, resting position to the protruded active posture. The erectile tissue merely acts as a hinge. At rest the organ is reverted into the cloacal



Fig. 2

Copulatory organ of *Crocodilus palustris* Lesson.

lit., i.e. it is retracted backwards bringing the sulcus nearest the vertebral column and the extremity pointing backwards towards the tip of the tail. When erected the position of the organ is reversed, the distal end pointing forward. In this position the sulcus is brought below (and is 'ventral'). It is this change in the position of the sulcus that confounds the field-worker. Viewed

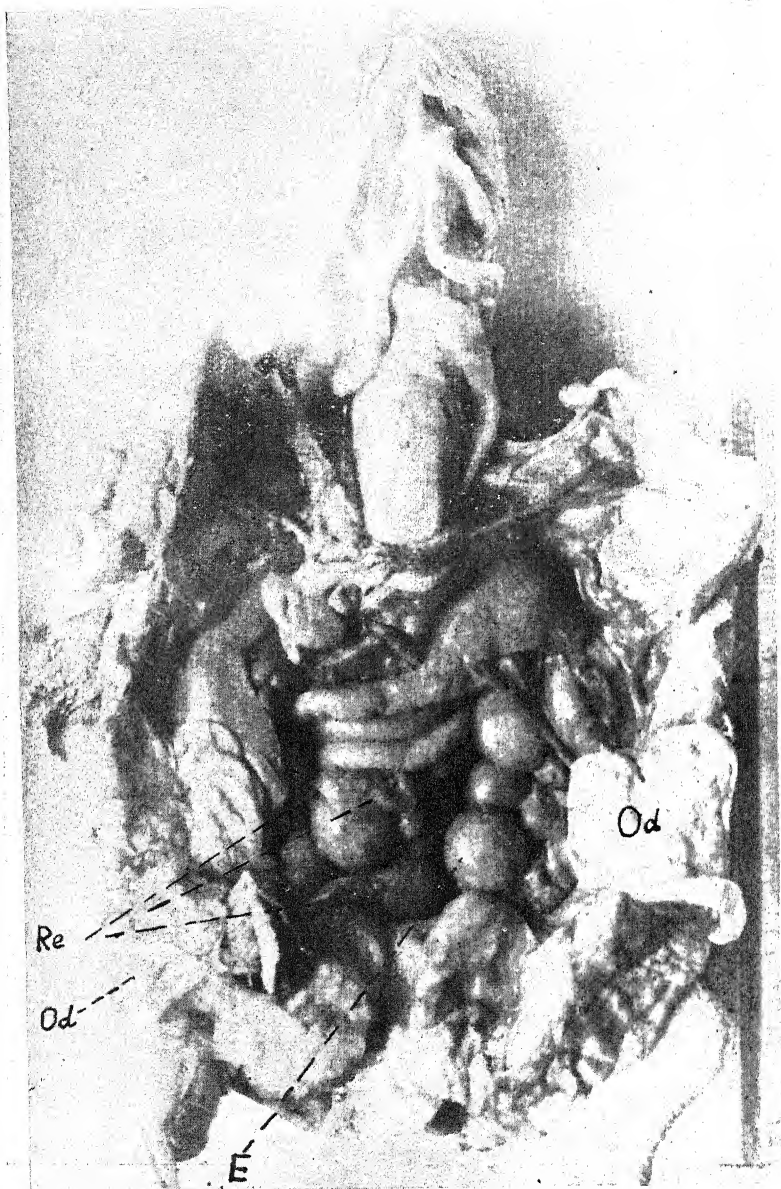


Photo :

C. McCann.

***Lissemys punctata gravosa* (Schoepff.).**

A gravid specimen showing the greatly enlarged condition of the genital system.  
E., eggs; Od., oviduct; Re., ruptured eggs.

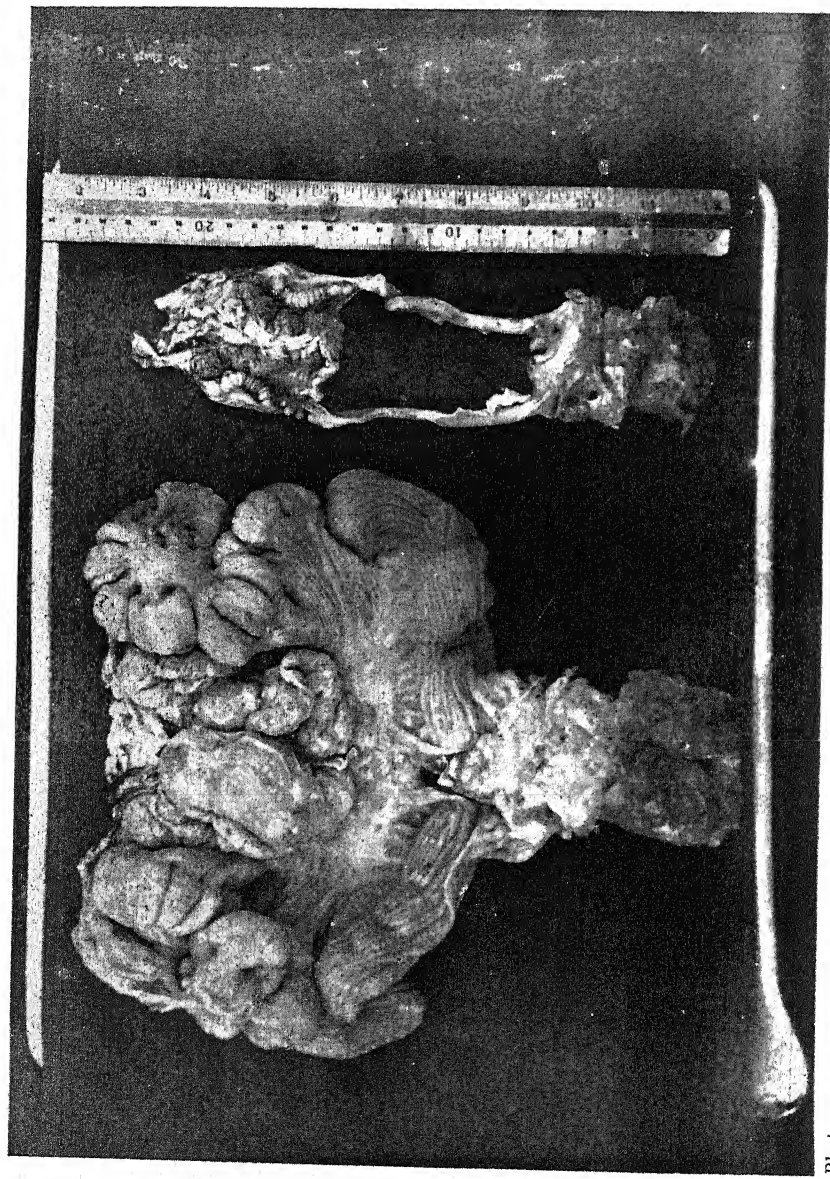


Photo :

*Crocodilus palustris* Lesson.

Active (left) and dormant (right) ovaries.

C. McCann.



from below, i.e. the side of the sulcus, the penis appears as though it were composed of two halves, the sulcus forming the dividing line. At the proximal end the fibrous tissue forms two large reversedly club-shaped bodies (*Crus*) narrowing towards the distal end and then widening again to form the terminal lobed extremity. The sides of the penis between the two extremities are somewhat flattened about the middle. Viewed in profile there is observed a distinct upward bend about the middle of the organ. The distal extremity is enlarged, and as already mentioned, lobate. There are two main lips; the upper forming a rigid hood over the cavity formed between the two; the upper lip is firm, broadly ovate, with a deep cleft at its tip; the lower is boat-shaped and slightly in-curved and exceeds the upper lip in length; its distal extremity terminated in two somewhat triangular flaps on either side of the sulcus. From the lower lip a median ridge, which increases in height, runs down into the cavity formed by the two lips. The sulcus arises out of a tubular structure at the proximal end, between the fibrous bodies, and extends forward to the extremity of the lower lip, it is bordered by subfleshy ridges. The structure and position of the organ suggests a ventral union of the sexes and a copulatory hold during coitus. However, the correctness of this suggestion must be proved by actual observation. It also seems possible that coitus in these bulky animals takes place in water.

#### THE FEMALE CLOACA.

A reference to copulation without a consideration of the female genitalia and its morphology would be incomplete, therefore I must give a brief description of it as well.

The text-books make no reference to the female cloaca in particular, but describe the cloaca in general terms which apply to both sexes. However, for the purposes of this paper it becomes necessary to differentiate not only between the cloaca of both sexes, but to consider them *in* and *out* of the breeding season. There is little or no change in the case of the male, except for the fact that the testes and ducts display a marked reduction or increase in size according to the seasons. In the female, however, there are very marked physiological changes which take place from the active to the inactive condition of the ovaries. This point is perhaps well-known, but I drew attention to it in my articles on *Amphibia* and *Reptiles* published in the *Journal*. The changes are of particular significance when we consider the subject of copulation, particularly in reptiles with bifid introversal organs.

*Snakes*: The cloaca of a female snake, when its ovaries are in an advanced state of activity, is not as well defined into three compartments as in lizards. The coprodaeum is confluent with the hind end of the gut from which it is barely distinguishable. In a fresh state (as in lizards) its opening almost reaches the last chamber or proctodaeum thus preventing the fouling of the middle chamber or urodaeum to any great extent. The urodaeum is formed by a dorsal invagination into a comparatively enlarged, saccate chamber which opens posteriorly into the proctodaeum.

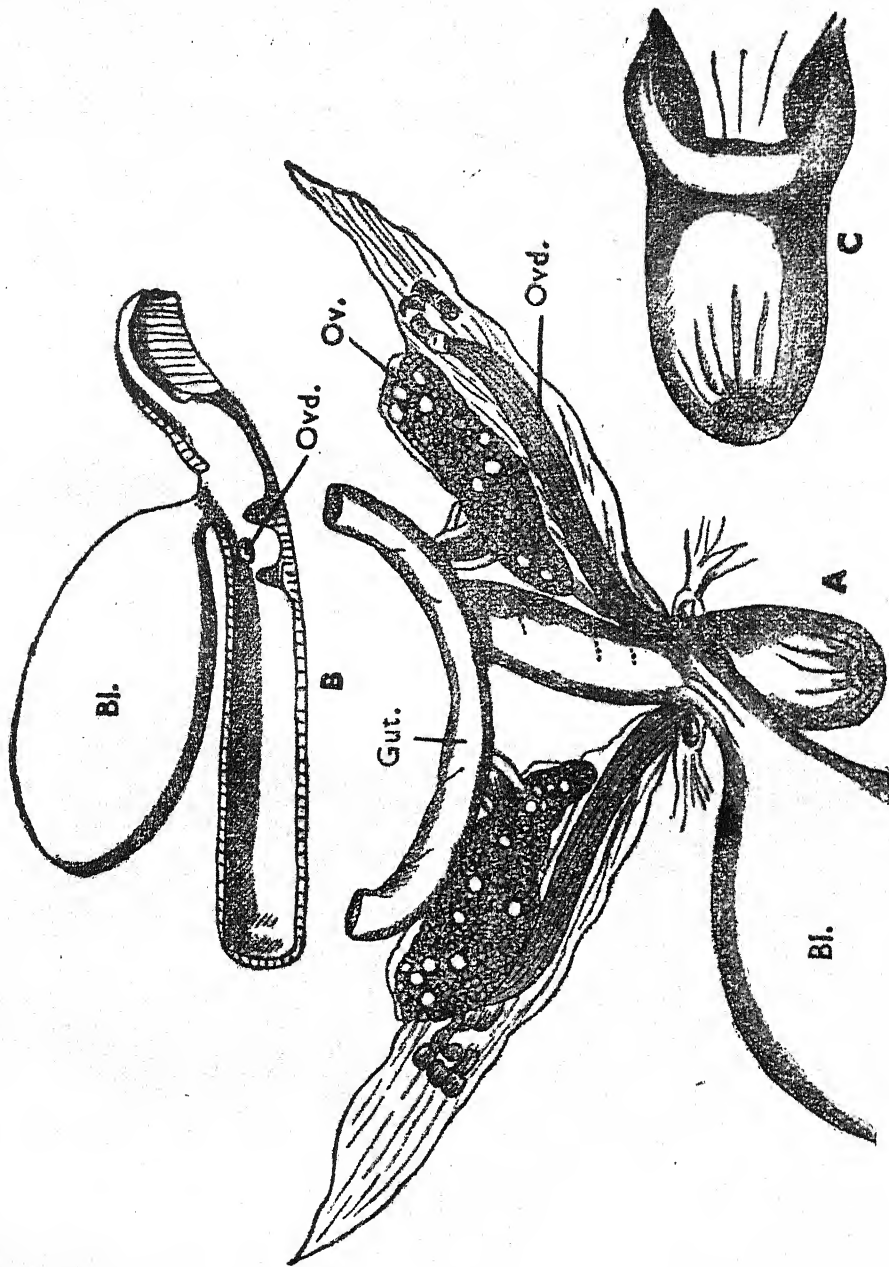


(The proctodaeum is comparatively short. The wall of both the urodaeum and the proctodaeum are thrown into longitudinal (fluted) folds. The proximal ends of the oviducts are considerably enlarged into oblong, thick-walled, glandular chambers which open directly into the dorsal portion of the urodaeum. These chambers apparently function as 'shell glands'. Unlike the lizards these 'shell glands' are not separated by a narrowed portion of the oviduct from the urodaeum. This description is based on median sagittal sections made through the cloacas of preserved specimens of *Natrix stolata* (Pl. VI, E,F.) and *Naja naja*, and a freshly killed *Ptyas mucosus*; all gravid. I could find no appreciable difference between the species. It is worthy of note that, apart from the general reduction of the organs during the inactive ovarian period, the opening of the oviducts are closed.

*Lizards*: According to my observations the cloaca during the active condition, is as follows: (Pl. IX F.—H.)

The cloaca is well differentiated into three compartments, the coprodaeum, urodaeum, and the proctodaeum. The coprodaeum at its hindermost end forms a mammilate, extensible tube which enters the urodaeum. It is supported by a suspension membrane from the mid-dorsal line of the urodaeum. This membrane partially divides the urodaeum into two halves. The urodaeum is separated from the proctodaeum by a sphincter partition. On the dorso-lateral sides of the urodaeum, and just above the protruding end of the coprodaeum are the entrances of the oviducts. The entrances to the oviducts are large, the portion just above them is elastic and is easily dilated without undue pressure from within. The opening of the proctodaeum to the exterior is closed by a strong fold of the external skin. A point worthy of note, in passing; is that the mammilate portion of the coprodaeum, suspended within the urodaeum is able, on extension, to reach the orifice formed by the sphincter separating the urodaeum from the proctodaeum, a device which probably prevents the fouling of the urodaeum during defaeciation. (The above description is based on a freshly killed specimen of *Hemidactylus maculatus* in breeding condition.) (Pl. IX, figs. F—H.) IX, D,E.

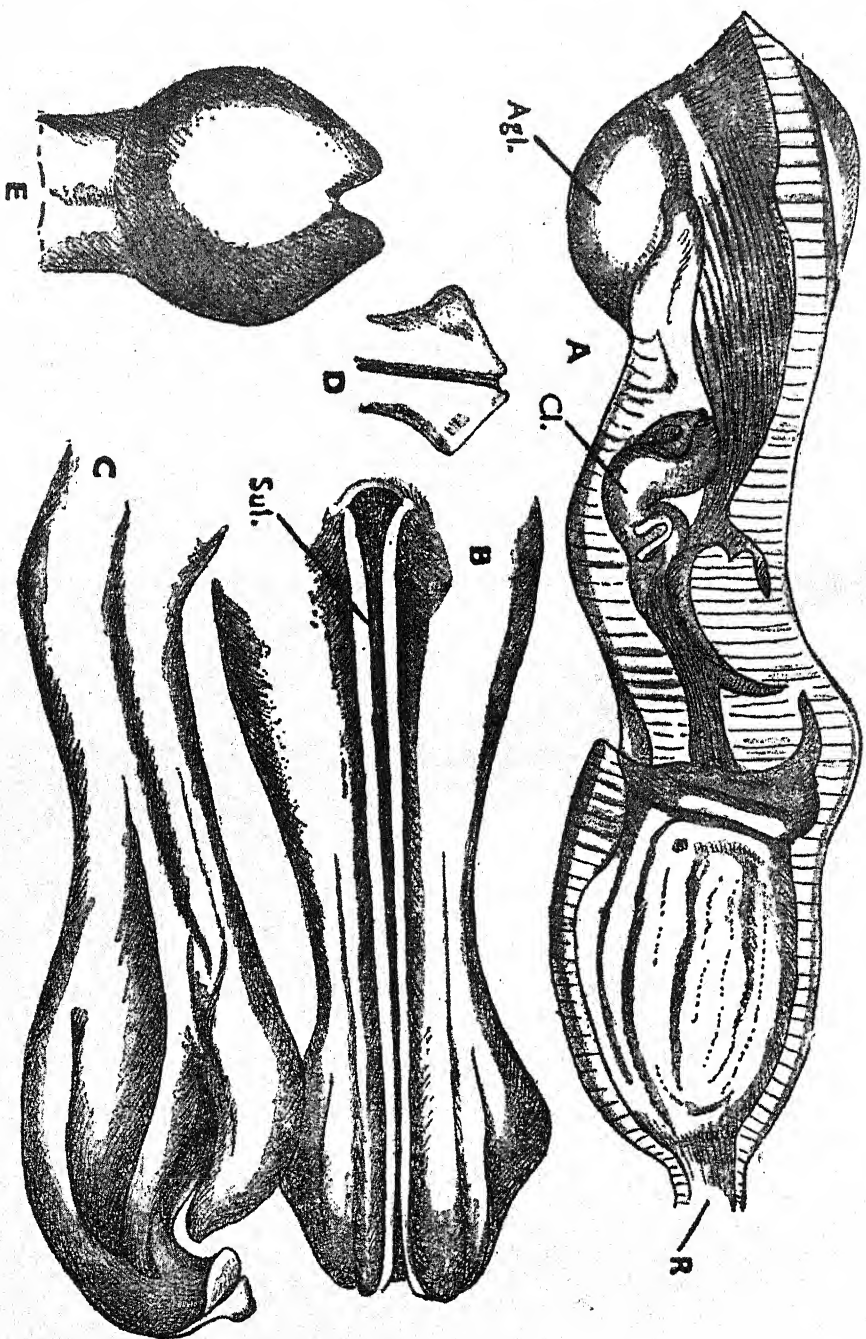
*Testudines*: The cloaca of a female mud-turtle (*Lissemys punctata*) during the period of ovarian inactivity does not exhibit a clear differentiation into the chambers characteristic of the lizards. The terminal portion of the gut is cut off from the urodaeum by a sphincter. Posterior to this sphincter another sphincter shuts off the much reduced urodaeum from the rest of the posterior end of the cloaca. Beyond the posterior sphincter the urinary bladder opens on the ventral floor of the cloaca. Immediately following the narrow neck of the bladder is a dense-tissued collar, the arms of which reach to the posterior sphincter. From the dorsal surface, but outside the passage of the proctodaeum, arises a solid, fibrous, clitoris-like structure which protrudes into the cloaca, but not through its wall; this body is seated on a somewhat spongy base which allows of a certain amount of movement to it. The walls of the proctodaeum are thrown into somewhat obscure folds. The oviducts enter the much reduced urodaeum and in this



Del. C. McCann.

Uro-genital system of *Lissemys punctata granosa* (Schoepff.).

A, entire system; B, long-section through cloaca; C, terminal, portion of cloaca; Bl., bladder; Gut., portion of alimentary canal; Ov., ovary  
Ovd., oviduct.



condition of sexual inactivity they are imperforate; the openings are somewhat laterally situated. (Pl. IV, B.)

In an example exhibiting ovarian activity in an advanced state there is a considerable enlargement of the oviducts and the now perforate openings. The ova occupy much space in the abdominal cavity. (Pl. II.)

*Crocodylia*: The text-book descriptions of the cloaca in these Saurians are as follows:

*Sedgwick* (4): 'The cloaca is divided into two parts by a muscular fold. Into the anterior chamber open the urinary and generative ducts by separate and paired openings. There is no bladder. On the ventral side of the posterior chamber of the cloaca is a grooved penis very similar to that of *Chelonia*. Peritoneal canals are present in both sexes and open on either side into the cloaca at the base of the organ.' (*l.c.*, p. 379.)

*Parker & Haswell* (7): 'In *Crocodylia* and *Chelonia*, instead of the copulatory sacs there is a median solid penis attached to the wall of the cloaca, and a small process or clitoris occurs in a corresponding position in the female.'

*Smith* (15): 'The cloaca is formed as follows:—The coprodaeum and urodaeum are confluent and form a large oval bag, closed in front and behind by strong sphincters. Normally it acts as a receptacle for urine, and into it also opens the oviducts, near the base of the clitoris. The proctodaeum or outermost chamber contains the large unpaired penis. This arises from the ventral wall of the chamber and has a deep longitudinal groove on its dorsal aspect to conduct the seminal fluid. On either side at the root of the penis opens the peritoneal canal. The outer opening of the cloaca is a longitudinal slit, and within it, placed dorso-laterally, are the two anal musk-glands.' (*l.c.* p. 34.)

The following are my own observations on the cloaca of a female crocodile during her period of ovarian activity:

The anterior chamber is large and is suspended dorsally by a strong suspension membrane. Internally the walls of the chamber are thrown into several deep, longitudinal folds: its posterior end widens into a large cavity; apart from the folds already referred to, the walls of the chamber are much vermiculately rugose throughout. From the posterior enlargement a narrow, much longitudinally fluted passage passes backwards under a dense-tissued, fluted, bulbous knob, arising from the mid-dorsal surface; the knob is posteriorly notched. Just beyond this dorsal protuberance, arises, from the ventral floor of this passage, a peniform clitoris with its distal extremity directed towards the opening of the vent. The walls of this passage are deeply longitudinally furrowed. The oviducts are much enlarged and longitudinally furrowed. The oviducts both enter the anterior chamber of the cloaca, the openings being somewhat dorsal in position. (Pl. V, fig. A.)

In reptiles the period, between the commencement of the reduction of the gonads and the beginning of their regeneration to activity, corresponds roughly to the period when the desire for food is predominant, namely, the period when the animals are not aestivating or hibernating as the case may be. This period is devoted to feeding activity and the consequent storage of large accumulations of fat in tissues especially assigned for the purpose. The marked reduction in the size of the genital organs from the greatly enlarged active condition to the much reduced inactive state makes room for the accumulation of fat that would not be

possible if this change did not take place. At the end of the period of activity, the genitals once more commence to show signs of returning activity. It is at this time that the animals embark on their period of aestivation or hibernation as the case may be. It is during the inactive life of the animal that the genitals develop to their maximum. Most of the stored fat is gradually absorbed and the area occupied by it is once more filled to capacity by the enlarging genitals, particularly in the case of the females. Thus the animal's life may be divided into two main periods: (1) the feeding period, and, (2) the period of sexual activity (including the period of hibernation or aestivation and the actual union of the sexes).

In a female with inactive ovaries, the cloaca displays no marked peculiarities, for during that period the entire genital system is reduced to a minimum and in some instances the organs atrophy to such an extent that the animals become difficult to sex with any degree of certainty without careful dissection. On the contrary, when the ovaries are active there is a marked increase in the size of the ovaries themselves and a corresponding enlargement and appearance of the oviducts and the walls of the cloaca. Both the latter become more 'spongy' and furrowed to give the necessary elasticity for the passage of the eggs. The ova mature within the body cavity, and when ripe break away and enter the funnel-shaped opening, the *ostium abdominale*, of the oviducts. Fertilization takes place in the oviducts, for it is only when the ova are in a fairly advanced condition that coitus takes place. This has been my experience with such reptiles as I have observed and dissected after coitus. At this period the oviducts are at the fullest development and the apertures to the exterior are at their largest.

What are we to conclude from these observations? The only reasonable answer is that as the genitals are so reduced during the inactive period, coitus is physically impossible, and as far as I am aware does not take place, not to mention the possible absence of any desire to cohabit during such a period (the reproductive organs being reduced or atrophied. There is no marked reduction in the size of the hemipenis).

From these considerations we must pass on to the postures assumed by reptiles during coitus.

#### POSTURES ASSUMED DURING COITUS.

*Snakes:* Snakes have no limbs. The copulating pair, like a fighting couple, at first entwine themselves, rope fashion, and approximate the vents. It is only then that the male organ is inserted and coitus ensues. Whether the male uses its jaws in obtaining the first hold on the female, I am unable to say, but as I have observed a similar practice in other reptiles, such as lizards, I am inclined to the view that the same may obtain among snakes. Once the sexes are united in copula it appears to be immaterial whether they remain entwined or not. On this point we have some meagre evidence.

Col. Wall (10) writing in the *Journal* on the evidence of Mr. Hampton wrote the following in regard to a couple of cobras (*Naja naja*):

'In Trivandrum the pair remained coupled from 11 a.m. until 4-20 p.m. on the 17th January. In Mr. Hampton's vivarium coitus lasted intermittently for three days. He observed that the pair nodded their heads continually, and their bodies quivered. They did not take the slightest notice of anybody in front of the cage. They did not expand their hoods, neither did they wrap themselves around one another. Each turned the vent upwards and sideways to effect engagement.' (xxii, 550.)

Unfortunately the observer tells us nothing of the first engagement and so we must conclude that he did not witness it and that the observations refer only to the period after engagement had already taken place. Some important details arise out of these observations, namely, (a) coitus may be protracted for several hours; (b) that it is repeated periodically, (c) that the couple were not entwined during the process. Similar facts I have observed in certain lizards. Another instance of snakes in copula was recorded in the *Journal* together with a photograph by Mr. A. R. Poyntz (14). In this instance the animals concerned were sea snakes. They were hauled out of the sea by means of a boat-hook. Both were entwined and remained so when put on shore, in spite of the rough handling. In volume xxxvi (15) of the *Journal* there is a plate illustrating two phases during the copulation of two Rat-snakes (*Ptyas mucosus*). Figure 2 of this plate shows the pair entwined, which appears to be an earlier stage than figure 1 illustrating the pair unwound, but with the two vents still approximated. However, further close observations are necessary on these details.

*Lizards*: Although lizards generally possess well-developed limbs I have observed no true copulatory hold in these animals. After a brief period of manoeuvring round, the male generally makes a rush at the female grasping her fiercely by his jaws at the back of her neck, often wounding her in the effort. The vents are approximated and the union of the sexes ensues. At this juncture the male releases his partner's neck and remains stationary until separation takes place. The duration of coitus varies and is repeated at intervals. Like snakes, lizards possess a divided copulatory organ. A point that is worthy of mention in passing, is that coitus usually takes place when the ova are already in the oviducts. I shall have occasion to refer to this point later.

*Testudines*: During coitus the male supports itself on the shell of the female, and remains in position by its own weight, but there is no hold in the true sense. It is common knowledge that the plastron in many species is very distinctly hollowed in the males. The sexes may remain in the copulatory attitude for a considerable length of time.

*Crocodiles*: I can find no reference to a pair of crocodiles having been observed in copula, hence we have no information on the subject as to the presence or absence of a copulatory hold.

After considering the copulatory poses assumed in the various groups of reptiles, we find that it is among such groups as do not employ a true copulatory hold during coitus, that we



find a paired organ. In both groups the period of union is usually protracted and separation takes place only after retraction of the organ. As there is no hold to secure the sexual position till the act is consummated we must turn once more to the structure of the organ when it is everted to its fullest for an explanation of its functions. A pertinent question arises as to whether we are dealing with a single or dual organ. This point must be disposed of first.

### IS THE HEMIPENIS A SINGLE OR DUAL ORGAN?

The word *hemipenis* itself suggests that we are dealing with 'half' an organ. The point is, Do the two halves unite together to form a single organ, or, does each part form a separate functional organ, one independent of the other? As already indicated, each hemipenis (when everted) has a longitudinal groove, the proximal end of which is confluent with the opening of the ureter to which the seminal ducts are connected and through which the seminal fluid enters the sulcus up the hemipenis. Then there are the very significant points that (a) both hemipenes are everted when pressure is applied to a certain point below the vent just above the organ (at rest); (b) when forcibly everted there is a strong tendency for the two to curve outwards, i.e. away from each other (this and the previous point I have confirmed repeatedly by experiment); (c) there is the fact that the head of the penis is much dilated when fully everted; (d) there is no copulatory hold during actual coitus in animals that possess a hemipenis. Taking all these points into consideration I am inclined to the view that we are dealing with a single organ composed of two halves. The reasons for such an opinion are perhaps obvious, but for sake of clarity it will be better to express them:

- (a) the two halves of the organ when everted together result in approximating the two sulci, thus forming a 'complete' tube at least in its lower portion for the conduction of the seminal fluid;
- (b) the dilated heads of the organ establish a firm copulatory hold within the female, thus dispensing with the need for an external hold during coitus.

From these considerations and conclusions we must pass to another aspect of the cloaca. In snakes and lizards the openings of the oviducts to the exterior are very near the vent itself, they open into the urodaeum. There is no vagina as in higher animals. Such large organs as the hemipenis when fully everted could not be accommodated in the cloaca alone. This to my mind is a very significant point. In the crocodiles and chelonians there is sufficient space to accommodate the penis. Again, it must be remembered that more often than not, the ova in both oviducts are fertilized. Spermatozoa received into the cloaca alone would, I think, in all probability not reach the ova to produce maximum fecundity as is generally the case. I readily realize that this view may call forth serious objections on account of the motility of spermatozoa, but, for the present I introduce the suggestion merely by way of argu-



ment. Another point not to be lost sight of is the absence of the copulatory hold in animals possessing a hemipenis, namely snakes and lizards. Taking these points into consideration, I am of the opinion that at the time of coitus both halves of the organ are inserted, and further, that the distal heads enter the openings of the oviducts themselves. The large heads thus provide a sufficient lock to prevent the extraction of the organ during the passage of the seminal fluid. The union of the lowest portions of the two sulci form an adequate tube in the cloaca, and the upper portions a passage into the oviducts.

A point perhaps worthy of consideration is that snakes and lizards are 'belly walkers'; the body being usually adpressed to the ground. In animals with such a mode of progression a median, enlarged, solid penis would be somewhat of a hindrance during progression. The saccate, reversible and divided organ is more comfortably accommodated under the caudal vertebrae, apart from the fact that they perform the function of claspers during coitus. Another point worthy of note, though it has no direct bearing on the subject in hand is, that according to Wall's (12) observations the hemipenis is extruded in embryos. He wrote as follows:

'The brood (of *Hydrophis spiralis*) in an advanced stage of development included 10 males and 4 females. The males (with the genitals extruded) measured...' (xxvi, 432).

Again in regard to the embryos of Russell's Viper (*Vipera russelli*) the same author states:

'The genitalia of the male are extruded up to about four days before exovation.' (xxvi, 432).

Having reviewed the many and complex aspects of sexual activity in the various groups, I shall now pass on to the description of the male genitalia in the species I have had the opportunity of examining in freshly killed animals. I also introduce the descriptions given in the *Fauna* (23) and those of Col. Wall in his various works by way of comparison.

#### DESCRIPTIONS OF THE MALE GENITALIA UNDER SPECIFIC HEADS.

##### Serpentes or Snakes.

###### BOIDAE.

###### ***Python molurus* (Linn.) (Pl. I fig. 4. & VII fig. 1.)**

The hemipenis of *Python molurus* and *P. reticulatus* are defined in the quiescent state in the *Fauna* (23) as follows:

'It is forked for about half its length, the lips of the sulcus being very prominent; throughout the whole length there are longitudinal folds, and just proximal to the point of bifurcation of the sulcus there is a fleshy tongue-shaped papilla; there are no spines.' (l.c., p. 105.)

**Everted aspect:** In the fully everted condition the hemipenis resembles the fruit of *Trapa bispinosa* (the Water Chesnut) on its pedicil. The pedicil is well differentiated from the head; it bears no spines or excrescences but just below the base of the head are

two distinct fleshy collars almost entirely encircling the pedicil. They are broken by the sulcus. The lower of the two collars is stouter and exhibits a nodular excrescence on the side opposite to the sulcus. The upper is feebler and undulated. The head is broadly triangular in outline with a retuse depression at the distal extremity. The two free ends of the triangle each bears a slightly recurved papilla at the base of which are a few fascet-like depressions. The surface of the pedicil and the head exhibit very shallow fissures which probably represent fold lines. The sulcus arises at the base of the organ and is represented by a comparatively deep groove bordered by somewhat stout ridges. At the base of the head the sulcus branches dichotomously, the branches turning towards the outer faces of the head and finally terminate in the grooves below each papilla. The outer margins of the sulcus are surmounted by fleshy folds which have a tendency to turn inwards.

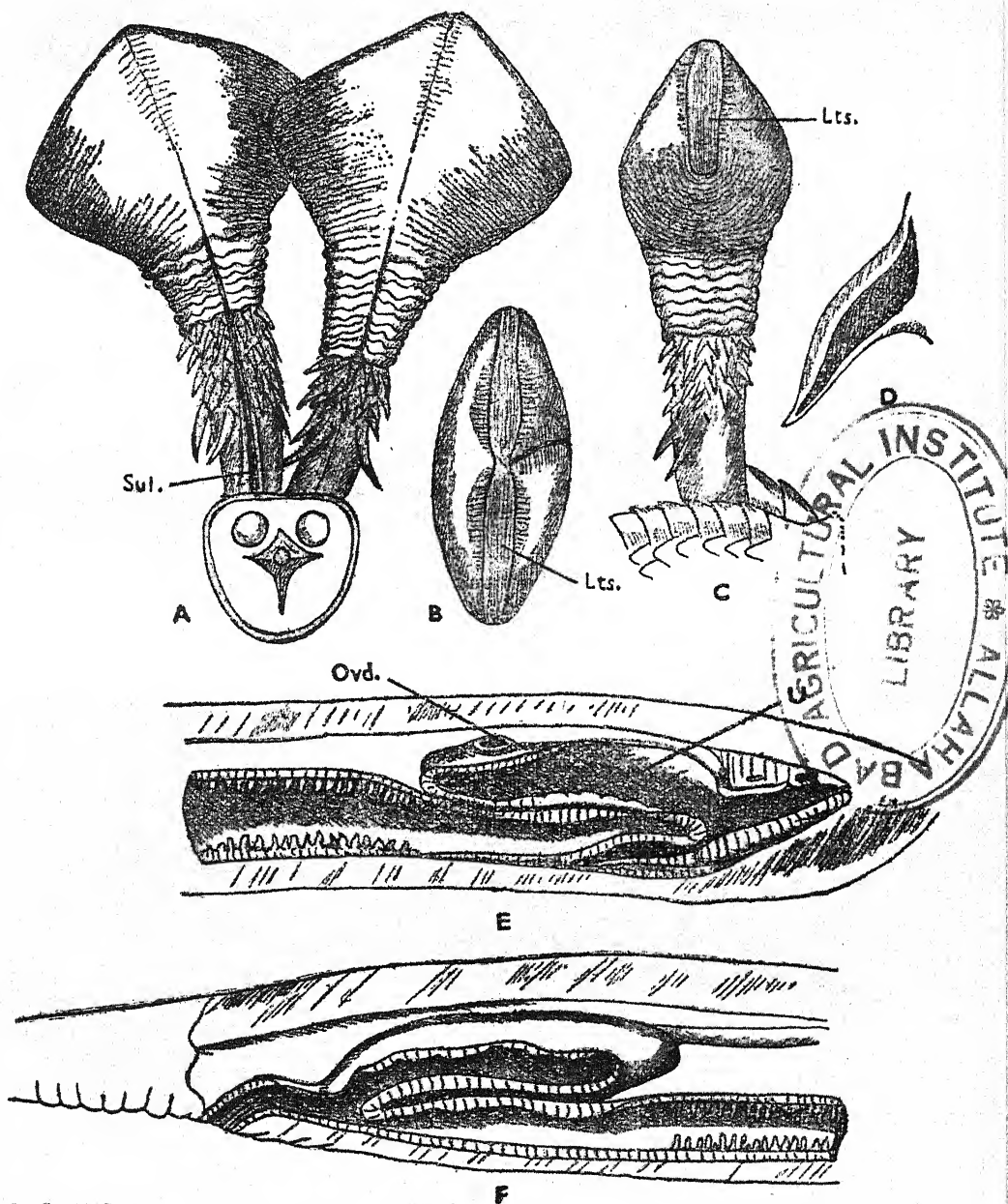
#### COLUBRIDAE.

**Ptyas mucosus** Smith (Pl. I fig. 6 & 7) (Pl. VII fig. A-D.) & text-fig. 3.

The *Fauna* (23) describes the hemipenis as follows:—

'Hemipenis extending to the 10th-12th caudal plate, not forked. The distal one third is flounced, the folds at the tip being much finer than those proximally: this area is followed by one of almost equal length in which the flounces are much thicker walled and joined together in part to form the calyces; it is succeeded abruptly by a spinose portion, the spines being thick and fleshy, and terminating in a spicule; there are 11-12 in lateral series; at the base of the organ there are two very large spines. In addition the distal one-half or one-third is incompletely divided in two by invaginations of the external wall of the organ. The connection between them is maintained by connective tissue and is intimately connected with the sulcus. In general character the structure is that of *Zaocys carinatus* but the modifications are less developed.' (*l.c.*, p. 160.)

*Everted aspect:* In the fully everted condition the hemipenis of *P. mucosus* is more complicated in structure and more difficult of description than that of *Python molurus*. The pedicil, which is well defined, supports a broadly quadrangular head which rests on one of its angles. For a short distance the proximal end is smooth all round; this is followed by an area of spines of almost equal length, the spines decreasing slightly upwards. At the base of the spinous area, on the side opposite to the sulcus, there are 2-4 spines much larger than the rest; the spines on the same side as the sulcus are smaller than those opposite. Each spine has a hard whitish core surrounded by translucent tissue. The extremity of the core protrudes externally as a sharp spicule. Immediately above the spinous area there is a deeply flounced area extending to the base of the head, the flounces decrease in size upwards and pass into the rugose area of the head. The flounces encircle the pedicil but their continuity is interrupted by the sulcus on the inner aspect.



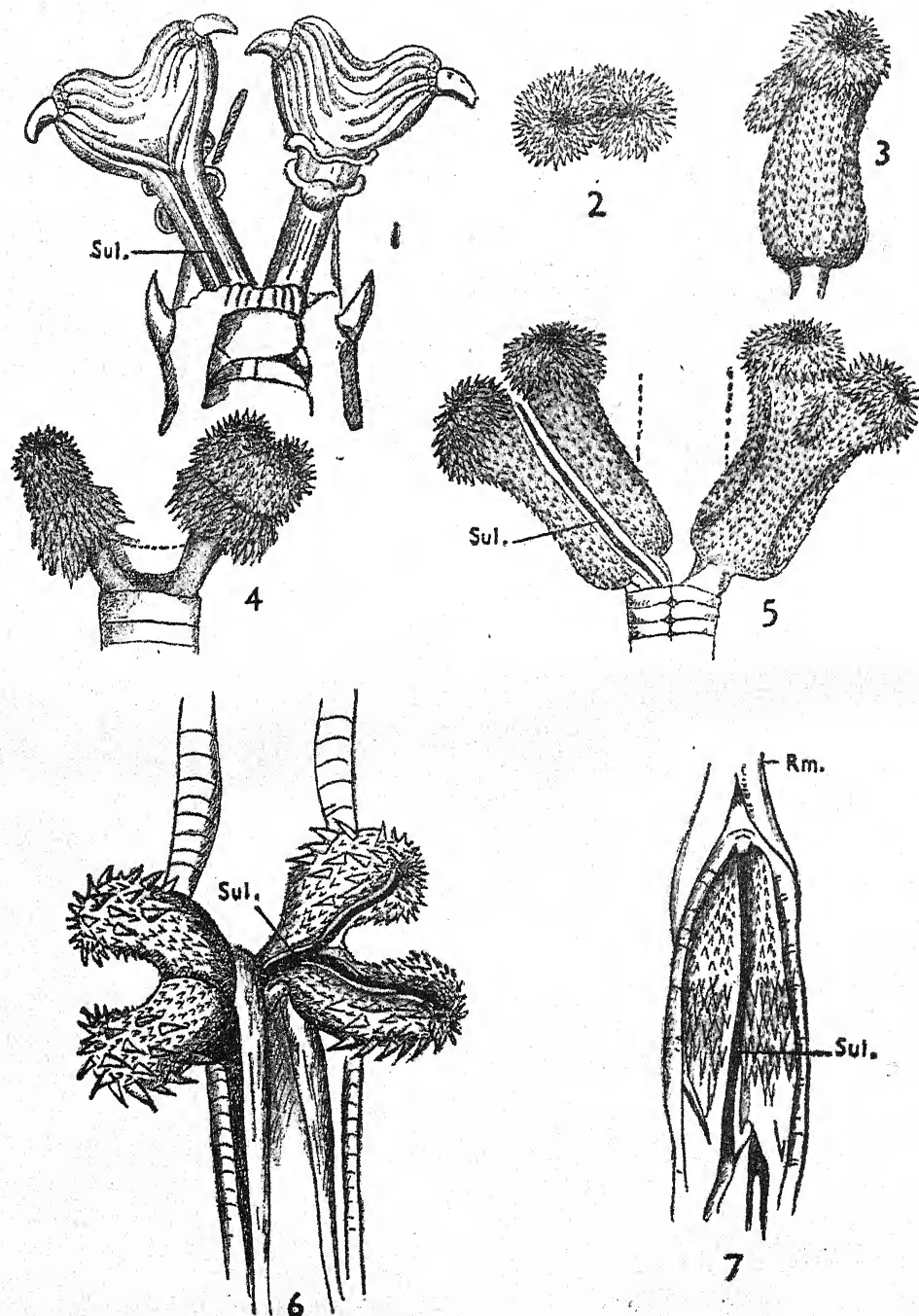
Del. C. McCann.

**Hemipenis of *Ptyas mucosus* Günther—A-D.**

A, The paired organ back & front; B, Top view; C, Lateral aspect; D, Spine;  
 Sul., Sulcus; Lts., lateral rib.

**Cloaca of *Natrix stolata* Pope—E. & F.**

Cloaca of a female with eggs in the oviducts, showing enlargement of urodaeum.  
 Ovd., oviduct; U., urodaeum.



Del. C. McCann.

Hemipenes of Snakes.

- 1, *Python molurus* (Linn.); 2, 3 & 5, *Natrix piscator* (Schneider); 4, *Bungarus caeruleus* (Schneider); 6, *Vipera russulii* (Shaw), everted; 7, *V. siamensis* Smith (drawing after Smith) reverted.

The quadrangular head when fully distended is somewhat transparent, especially towards the distal region. The angles are rounded. The supporting stays of somewhat cartilaginous tissue are clearly visible extending from the two lateral angles to the distal or topmost angle (Fig. 3. Lts.). The surface of the head is shallowly flounced below, the flounces gradually passing into oblique rugose ridges which become almost obscure or obsolete towards the central area, but reappear along the central axis. The sulcus is well defined along the pedicil but gradually fades out except for a ridge along the wall of the head. On the opposite side to the sulcus there is also a fine ridge corresponding to it in position. At the base, the sulcus is bordered by somewhat strong ridges.

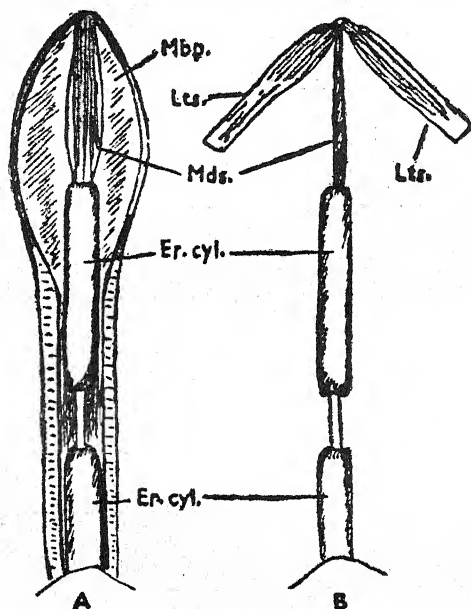


Fig. 3. Diagrammatic sections of the hemipenis of *P. mucosus*. Er. cyl.=erectile cylinder; Lts.=lateral stays; Mbp.=median septum; Mds.=median stay.

3. Mds.) reaching the top of the head. At this point the ligulate structure supports two semi-cartilaginous 'stays' which extend to the lateral corners. A thin transparent membrane (Fig. 3. Mbp.) divides the interior of the head into two; it extends from the side of the sulcus, across, to the opposite wall.

*Internal aspect:* A long section of the hemipenis exhibits the following: Within the pedicil there are two cylindric bodies (Fig. 3. Er. cyl.) of erectile tissue separated from each other by a much finer cylinder. Both the large cylinders are attached to the walls. The upper of the two extends for a short distance into the head. At its distal end is ligulate somewhat cartilaginous body (Fig.

#### ***Coluber ventromaculatus* Gray & Hardwicke.**

The *Fauna* (23) describes the hemipenis as:

'Hemipenis extending to the 10th caudal plate; the calyculate area occupies 1/3 of the organ, the cups being deeply scalloped and spinose; this area merges gradually into a spinose one, the spines being more or less uniform in size; there are about 20 lateral series.' (*l.c.*, p. 168.)

Col. Wall (11) writes:

'The ♂ claspers in adults are studded with hook like horny appendages' (xxiii, 41.)

**Lycodon striatus** (Shaw) Stoliczka.

The *Fauna* (23) describes the hemipenis of this species under *L. jara*; it reads:

'Hemipenis extending to the 10th caudal plate; the distal  $\frac{1}{3}$  is obliquely flounced and calyculate, the remainder of the organ spinose, the spines being large and more or less equal sized throughout.' (*l.c.*, p. 261.)

Col. Wall (6) writes:

'The male organs are beset with numerous minute claw-like appendages.' (xix, 104.)

**Lycodon aulicus** (Linn.) Guenther.

Regarding the hemipenis the *Fauna* (23) states:

'Hemipenis extending to the 10th caudal plate; forked near the tip; the distal  $\frac{1}{3}$  is calyculate, the calyces being transversely arranged; the remainder of the organ has longitudinal folds which are beset with more or less distinct spines; starting from the calyculate portion of the organ and extending about half-way down, are two prominent folds composed of a number of short, flesh papillae.' (*l.c.*, p. 264.)

Col. Wall (6), writes:

'The copulatory male organs are beset with many minute recurved spines.' (xix, 97.)

**Everted aspect:** In the fully everted condition the hemipenis is comparatively short. The pedicil is stout, and occupies approximately  $\frac{1}{3}$  its total length being unarmed, and fully differentiated from the head. The head is somewhat obovately trigonous, and is armed with comparatively large curved spines, increasing in length towards the distal extremity. Each spine is embedded in a somewhat translucent membrane with a free and sharp extremity. The sulcus is deep, and extends up one of the angles terminating in the 'pit' formed by the invagination and is margined by thick lips.

**Matrix piscator** (Schneider) Smith (Pl. I fig. 5) & (Pl. VII. figs. 2, 3, 5.)

With regard to the construction of the hemipenis in the genus *Matrix* the *Fauna* (23) records the following:

'Hemipenis reaching the 7th or 8th caudal plate<sup>1</sup>, spinose and calyculate throughout, the spinies being more or less uniform in size. The lips of the sulcus are short or very short, the spines originating within the cup; at the base of the organ there are 2-4 large or very large spines.' (*l.c.*, p. 281.)

Under the specific head of *N. piscator*:

'Hemipenis extending to the 12th caudal plate, forked for about one-third of its length; it is spinous throughout, the spines being relatively coarser at the distal end than at the proximal; extending for the greater part of its length are four prominent folds; there are no basal spines.' (*l.c.*, p. 294.)

**Everted aspect:** In the fully everted condition the hemipenis of *N. piscator*, the large columnar head occupies the greater part of the organ. The pedicil is very short. The head is large, bluntly quadrangular and bifid at the extremity; each bifurcation terminates

<sup>1</sup> There is a slight discrepancy between these figures and that given under the specific heading below.

in a somewhat spherical head which is invaginated at the apex. The side opposite to the one bearing the sulcus exhibits a median prominent hump just below the division between the two distal hemispheres. The whole surface of the head is covered with small almost uniform recurved spines, except its basal end; in the distal region and on the hump the spines are a little larger. On the side of the sulcus very shallow fissures run obliquely upwards away from it, to the angles. The sulcus is well defined and runs up to between the lobes; at this point it bifurcates and furrows lead up to the invaginations at the top of the distal lobes.

**Atretium schistosum** (Daudin) Guenther.

Regarding the hemipenis of this species the *Fauna* (23) records:

'Hemipenis forked at the junction of the distal  $\frac{1}{3}$  and the proximal  $\frac{2}{3}$ , spinose and calyculate throughout; the calyces are thick-walled and present a honey-combed appearance; the spines are small and on the floor of the calyces.' (*l.c.*, p. 320.)

Col. Wall (9) states:

'The ♂ clasper is beset with numerous falciform processes from the base to the tip.' (xxi, 1013.)

**Psammophis condanarus** (Merrem) Boulenger.

The *Fauna* (23) refers to the hemipenis under the generic heading; it reads as follows:

'The hemipenis is long and extremely slender, so slender that I have been unable to make a proper examination of it from the material at my disposal. It has neither spines nor calyces but is provided with longitudinal folds. It does not differ from the five species dealt with in this book.' (*l.c.*, p. 362.—quotes Wall.)

Col. Wall (8) records:

'The male claspers I have found peculiar, differing from these organs in other snakes in that when forcibly extruded by digital pressure behind the vent they were directed downward instead of forward. They are thin, long, and spirally twisted reminding me of a black buck's horn. Again they are entirely lacking in asperities or tentacles such as one usually sees on these organs in other snakes.' (xx, 630.)

ELAPIDAE.

**Bungarus caeruleus** Boulenger. (Pl. I fig. 2.) & (Pl. VII. fig. 4.)

The description of the hemipenis in the *Fauna* (23) is applicable to the genus. It reads as follows:

'The hemipenis extends to the 6th-9th caudal plate; the distal one-third or half is calyculate, the remainder spinose. The calyces are smallest near the tip of the organ and increase in size as they approach the spinose area. Each cup is stiffened by spine-like structures, which, like the ribs of an umbrella, hold the membrane and project beyond the margin. The transition from the calyculate to the spinose area is fairly abrupt, the largest spines are those nearest the calyces; they are thick and papilla-like in form, and bear a small sharp spine at the tip. The bifurcation of the sulcus is about the middle of the calyculate area or at the junction of the calyculate and spinose areas, and the lips of the sulcus are beset with small spines throughout. I have found considerable variation within the species as regards the number and form of the spines.' (*l.c.*, p. 408.)



*Everted aspect:* In the fully everted condition the hemipenis of *B. caeruleus* is well demarcated into pedicil and head. The pedicil is comparatively short and slender, and its surface is smooth. The head is somewhat oblong or ovate-oblong with a distinctly retuse apex; about its middle there is a constriction which separates the two areas of large and small spines. The spines are larger in the lower portion while those above the constriction are smaller and prickly-like. The sulcus is somewhat shallow but is well defined; it bifurcates just below the retuse apex and the arms loose themselves among the prickles.

*Naja naja* (Linn.) Nikoloſky.

The *Fauna* (23) describes the hemipenis as:

'Hemipenis extending to the 10th caudal plate, forked opposite the 7th; it is divided into three areas, which are fairly abruptly defined from one another, namely a proximal one beset with minute spine, a median one with very much larger spines, and a distal calyculate area, the cups being poorly developed and having spinose edges. The median area is further interrupted by a narrow transverse, smooth area, which does not, however, intercept the sulcus or its two adjacent longitudinal ridges.' (*l.c.*, p. 429.)

Col. Wall (10) writes:

'The male clasper is narrow and long surmounted with very small claw-like tentacles. It is not bifid.' (xxii, 550.)

#### HYDROPHIIDAE.

##### *Hydrophis cyanocinctus*

Daudin. (Pl. I, fig. 1.) & Text-fig. 4.

The *Fauna* (23) describes the hemipenis as:

'Hemipenis forked near the tip, and spinose throughout, except near the base, where there are longitudinal folds; the edges of the sulcus are also spinose.' (*l.c.*, p. 455.)

*Everted aspect:* The hemipenis in this species is comparatively small with a strong tendency to recurve. In shape it is somewhat obconic. The pedicil is shorter than the spinous head and is somewhat lobate. The head is elongately subcylindric, narrowing towards the pedicil; its distal extremity is shallowly invaginated; its surface is spinose throughout with the largest spines nearest the pedicil (the difference in the length of the spines is not very marked). The sulcus is comparatively deep and its margins thrown into folds (rather lobed). It terminates in the invagination.

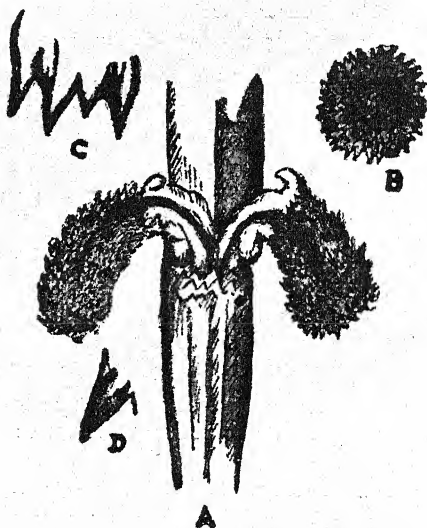


Fig. 4. Hemipenis of *H. cyanocinctus*:  
A. Entire organ; B. Top aspect; C. Multiple spine; D. Simple spine.

**Hydrophis caerulescens** Smith.

The description of the hemipenis in the *Fauna* (23) reads:

'Hemipenis forked close to the tip; this is furnished with coarse flattened, papilla-like structures arranged in longitudinal series; the remainder of the organ is spinose, the spines being of moderate size, closely set and becoming slightly larger as they approach the base.' (l.c., p. 463.)

*Everted aspect:* The hemipenis of this species is very similar to that of *H. cyanocincta* in shape and behaviour when everted. The pedicel is about half the length of the head and is somewhat lobate. The head is subcylindrically obconic; its surface is spinous, the spines being a little larger at the base than above. The fleshy investments of the spines are connected to one another. The sulcus is comparatively deep and its margins are lobed and spinous; it leads into the invagination at the distal extremity.

Col. Wall (3) writes:

'... the main stem when the organ is protruded, being about half an inch in length. . . . The organ of one side is invaginated as it would be during the act of coition. I have never observed this peculiarity in other snakes. Is it a viperine characteristic?' (xv, 526.)

*Note:* None of the specimens of *Hydrophis* I have so far examined exhibit a forked distal extremity.

## VIPERIDAE.

**Vipera russellii** Shaw. (Pl. I, fig. 3.) & (Pl. VII, fig. 6.)

In describing the hemipenis of *V. russellii* the *Fauna* (23) states:

'Hemipenis extending to the 10th caudal plate, forked opposite the 2nd to 3rd; calyculate in the distal half, spinose in the proximal, the largest spines being nearest to and extending beyond the fork.' (xviii, 483.)

Col. Wall (5) states again:

'The male genitals are peculiar. The clasper on each side is bifid, a character, I believe to be found in all vipers. I have also observed the same condition in the sea-snakes, but not in any other colubrines. In a male 3 feet 7 inches in length, the main stem of each clasper was about half an inch long.' (xviii, 13.)

*Everted aspect:* In the freshly everted condition the hemipenis of *V. russellii* naturally presents a very different picture from what is described above. The pedicel is extremely short and the distal end may be described as 'sessile'. What is visible of it is encircled by fleshy annuli. The head is remarkably U-shaped, the extremity of the two arms being deeply invaginated; its surface is covered with short prickles intermixed with large spines, the largest of which are restricted to the sides of the arms of the head, diminishing in size within the invaginations. The sulcus is comparatively deep, bordered by fleshy margins; it divides dichotomously and the branches lead up into the respective invaginations.

*Note:* I am indebted to Col. Sir Sahib Singh Sokhey, Director of the Haffkine Institute for presenting me with a living specimen.

### Sauria or Lizards.

In the *Fauna* (18) (vol. ii, Sauria) there is no mention either under the generic nor specific heads of the structure of the hemipenis in lizards beyond the general description given in the Introduction, already referred to. Evidently there has been no serious attempt at a classification based on the morphological characters of the hemipenis in the case of lizards as has been done in the case of snakes. However, after an examination of the limited material in my collection, it is clear that there is just as great a diversity in the morphological structure of the organ in this group as is exhibited in the snakes. For the purposes of comparison I have illustrated four types from four families, namely, *Gekkonidae*, *Agamidae*, *Chamaeleonidae*, and *Scincidae*. Very probably a further study of the subject will reveal that there are also differentiating characters between the genera and, perhaps, species, but here I must leave the subject.

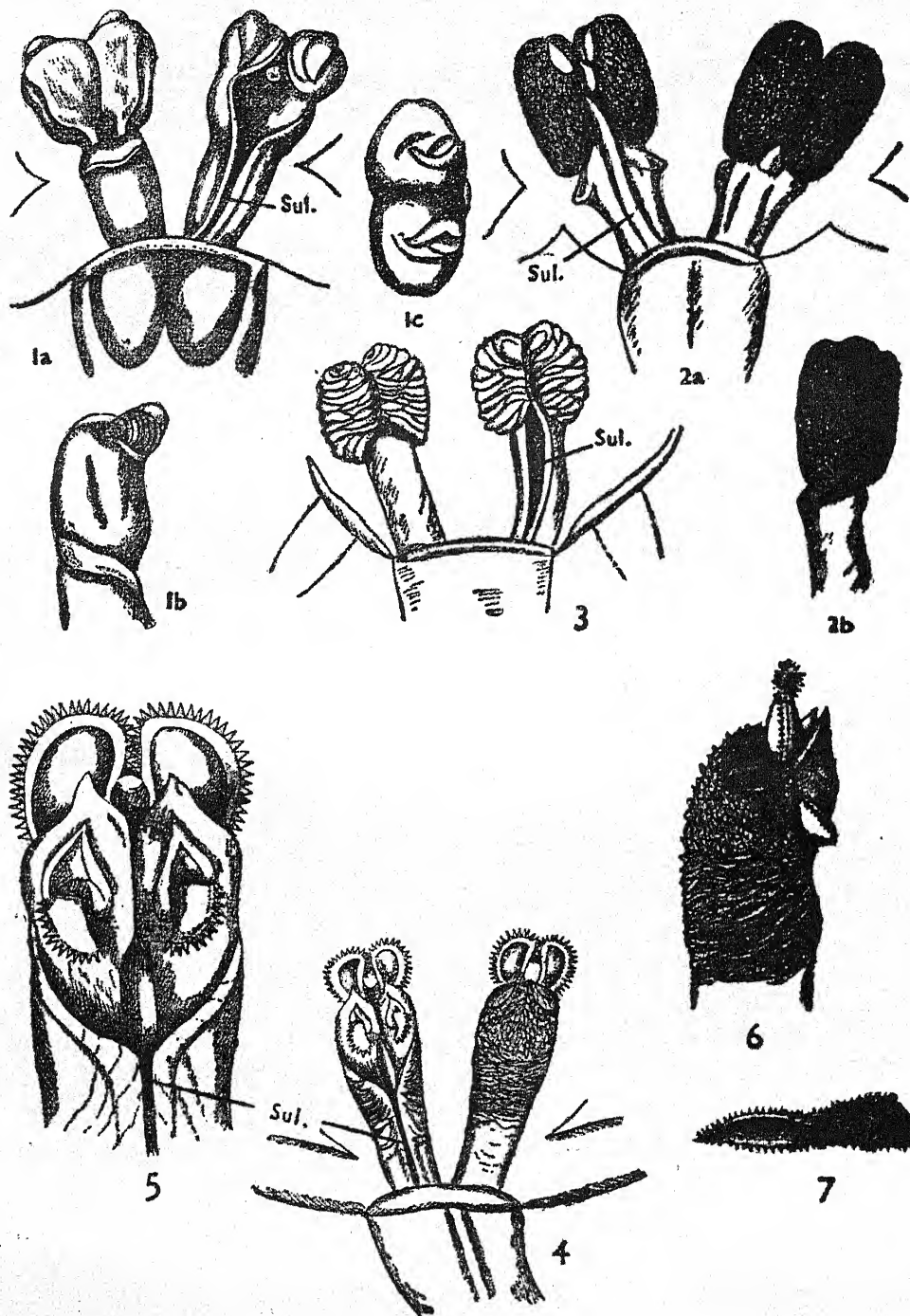
#### GEKKONIDAE.

##### **Hemidactylus maculatus** Smith. (Pl. IX, figs. D. E.).

*Everted aspect:* In the everted condition the pedicel and head are well defined. The pedicel is longer than the head; it is stout and is encircled by a thick, fleshy collar just below the head on the side opposite to the sulcus, the arms descending obliquely on the side of the sulcus where it descends to about the middle of the pedicel and its continuity is broken by the sulcus; the surface of the pedicel is smooth but a few fold lines are evident. The head is depressedly elliptical in outline and its surface is formed into several lobes; on the side opposite to the sulcus the lobes at the distal end are somewhat hemispherical; each lobe exhibits a cannaliculate depression at the top and a lateral ligulate excrescence; in the sinus between the lobes there is a somewhat rounded, elevated body; on the side of the sulcus the lobes are subdivided into minor lobes and elevations by a deep furrow; the surface of the head is marked with microscopic reticulations. The sulcus is deep, it opens out into a funnel-shaped depression distally, the sulcus is bordered by thick, fleshy margins.

##### **Hemidactylus brookii** Gray. (Pl. IX, figs. A-C.)

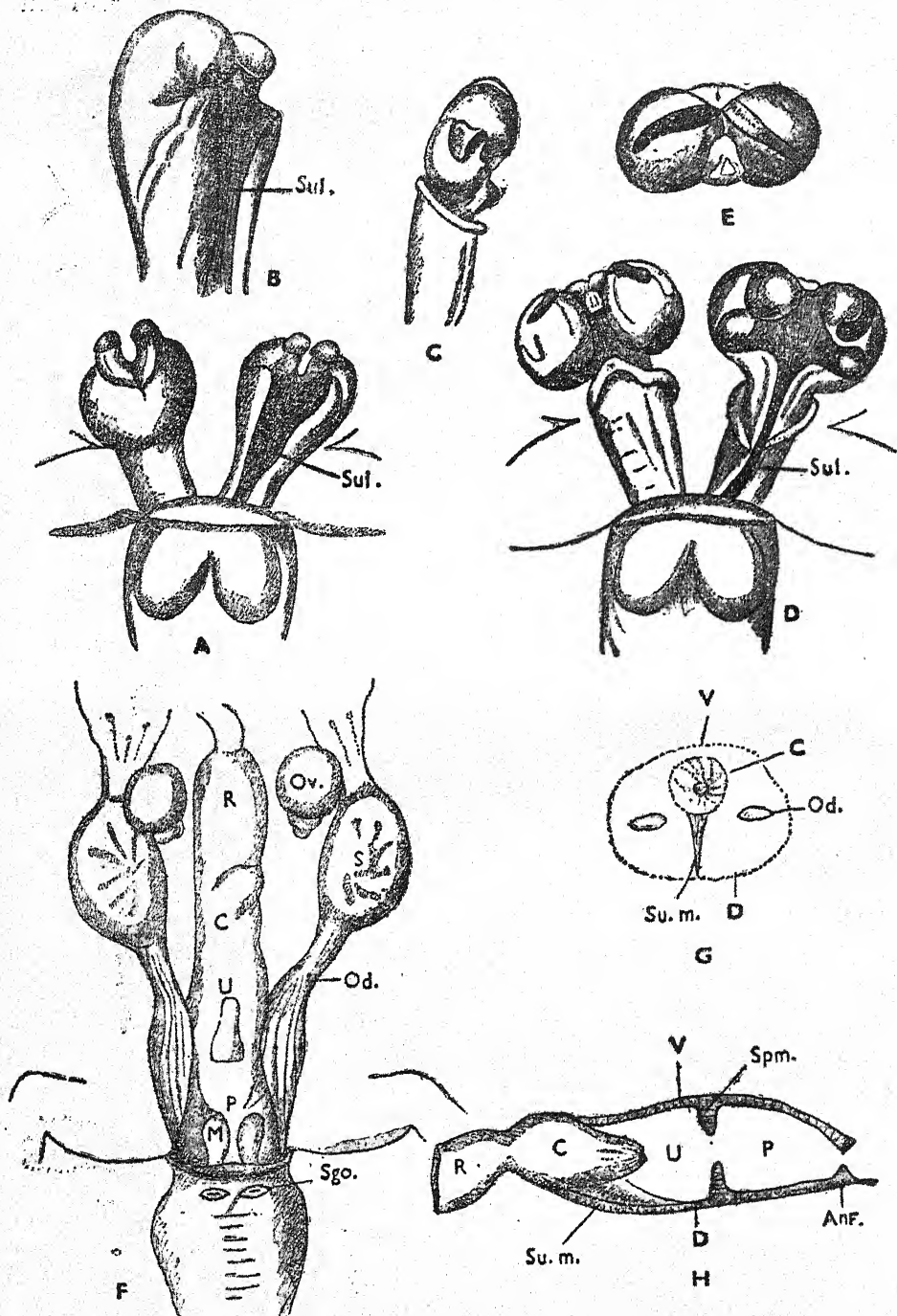
*Everted aspect:* In the everted condition the pedicel and the head are not distinctly defined. The pedicel is approximately as long as the head; it appears smooth unless viewed with a powerful lens or microscope, and then it is observed to be minutely, reticulately honey-combed. The head is shallowly bifurcated and lobate; in general outline it appears rounded; on the side of the sulcus, but from within its widened distal extremity, arise two short 'columns' each supporting a minutely papillate, hemispherical head; the surface of the head, like the pedicel is minutely, reticulately honey-combed, the honey-combing being largest on the shoulders. The sulcus is comparatively deep, and widens distally into a funnel-shaped depression finally passing between the bifurcation formed between the hemispherical nodules.



Del. C. McCann.

Hemipenes of Lizards.

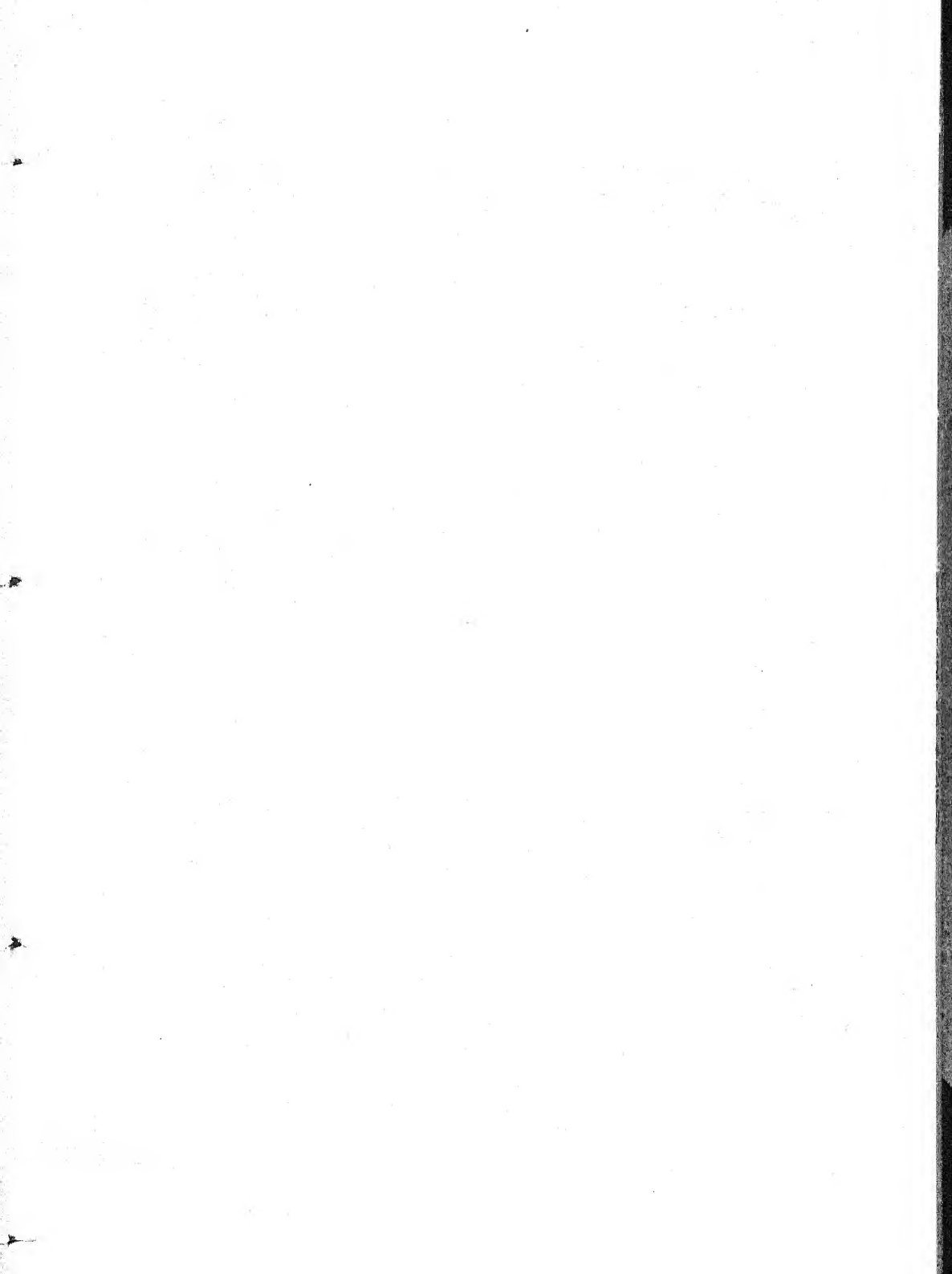
1a, 1b & 1c, *Hemidactylus flaviviridis* Rüppell; 2a & 2b, *Calotes versicolor* (Daudin);  
3, *Mabuya carinata* Boulenger. Sul., sulcus. 4-7, *Chamacleon zeylanicus* Laurenti;  
4, entire organ; 5, side of sulcus; 6, lateral view; 7, rugae.



Del. C. McCann.

Hemipenes and uro-genital system of *Hemidactylus*.A-C, *Hemidactylus brookii* Gray ♂; D & E, *H. maculatus* (Dum. & Bibr.) Smith ♂; F-H, *maculatus*, ♀.

Anf., anal sphincter; C, coprodaeum; D, dorsal; M, musk gland; Od., oviduct; Ov., ovary; P, proctodaeum; R, rectum; S, shell gland; Sgo., opening of scent gland; Spm.,





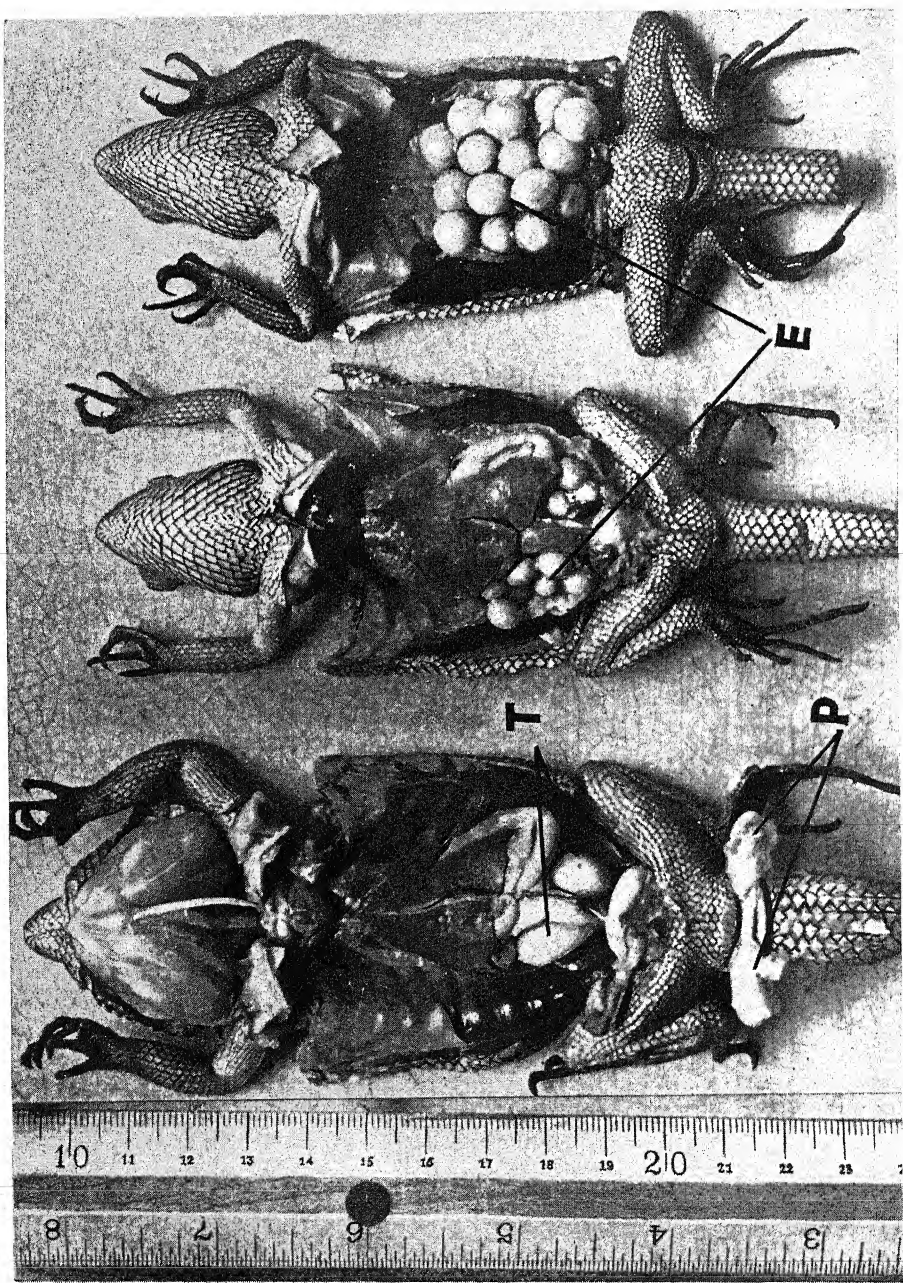


FIGURE 1  
The Bloodsucker [*Calotes versicolor* (Daudin)] Dissections showing condition of the reproductive organs in June.  
E. eggs; P. hemipenis, T. testes. (Scale in millimetres and inches)  
C. McCANN.



**Hemidactylus flaviviridis** Rueppell. (Pl. VIII, figs. 1a-1c).

*Everted aspect:* In the distended condition the pedicil and the head are fairly well demarcated. The pedicil is smooth, but minutely reticulately pitted under high magnification; on the side opposite to that of the sulcus, a transverse ridge is present just below the constriction between the pedicil and the head. The head is shallowly bifid and somewhat lobed; on the side bearing the sulcus the lobes are divided by a median thick tongue-like projection which is hollowed and furrowed on the outer side and rounded on the inner; between the lobes is a rounded elevated body; the side opposite that bearing the sulcus there are two obversely pear-shaped lobes on short 'pedicils'. The sulcus is deep and distally widens out into a funnel-shaped concaved area; the sulcus is bordered by somewhat thick margins.

## AGAMIDAE.

**Calotes versicolor** (Daudin) Jerdon. (Pl. VIII, figs. 2a, 2b.) & (Pl. X).

*Everted aspect:* The hemipenis in this species is well developed. The pedicil is slightly shorter than the head; below the head, it is broadened out into two shallowly concaved shoulders; there are no spines. The head is somewhat triangular in transverse section, and is oblong in shape. It is shallowly divided longitudinally into four lobes, two being very slightly larger than the others. On the side of the sulcus there is a funnel-shaped opening on either side, and above, of which there are two smooth oval areas; on the side opposite the sulcus, there is a small, somewhat elevated disc, notched proximally, and situated just below the division between the two larger lobes of the head. The surface of the head is reticulately pitted, the pits being larger on the outside and diminishing in size towards the divisions between the lobes. The sulcus is comparatively deep and is covered by a flap formed by the fleshy enlargement of one of its margins. The sulcus leads into the funnel-shaped aperture already described which in turn is in communication with the sutures descending into the hollow formed by the union of the divisions of the head.

## CHAMAELIONIDAE.

<sup>1</sup> **Chamaeleon zeylanicus** Laurenti. (Pl. VIII, figs. 4-7.).

*Everted aspect:* In the everted condition the hemipenis of the Chamaeleon is subcylindric with barely any differentiation between pedicil and head. It is one of the most curiously formed organs I have so far observed and is difficult of accurate description on

<sup>1</sup> The *Fauna* (vol. 2, p. 251) attributes the generic name *Chamaeleon* to Gronovius (1763); in the *Catalogue of Lizards*, vol. 3, p. 438, the authority for the same name is Laurenti (1768). According to the *Fauna* Laurenti used the name *Chamaeleo zeylanicus*. The spelling of the generic name is at variance, and, I believe, according to the Rules the authority for the new combination *Chamaeleon zeylanicus* should read (Laurenti) Smith, not merely Laurenti, but as I have no access to the Rules I merely raise this point out of interest.

account of its complex structure. The pedicil is approximately as long as the head; in its lower half it is almost smooth; in the upper half it is partially encircled by rugose flounces, the margins of which are very minutely serrated; on the side of the sulcus the flounces pass into oblique ridges and folds. The top of the head is crowned by two erect crescentic plates with serrated margins; on the side of the sulcus there is a glottis-like structure just at the base of the two crescentic plates, the top margins of this structure are also minutely serrated; near the middle of the head are another two crescentic plates fixed transversely to the long axis of the organ, the margins of these plates are also serrate; on the side opposite to that of the sulcus the head is covered by reticulately honeycomb-like pits, the margins of each pit being minutely serrated. The sulcus is deep and is bordered by somewhat thick margins; at the base of the head it widens out into a funnel-like cavity under the two transverse plates; mesially there is a groove between the plates.

#### SCINCIDAE.

#### **Mabuya carinata** (Schneider). (Pl. VIII, fig. 3.)

*Everted aspect:* In *M. carinata* the hemipenis is less complicated than in *Calotes*. The pedicil is well demarcated; it is columnar and without any spines or excrescences. The head is somewhat turban-like; on the side of the sulcus it exhibits two large, obliquely ovate elevations divided from each other by a shallow suture, the continuation of the sulcus; the surface is thrown into oblique, fleshy, turban-like folds and ridges. The sulcus is deep with one margin developed into a fleshy flap; it divides the head into two halves and terminates between the two large lobes at the distal extremity, already referred to.

#### CONCLUSION.

After paying much attention to the breeding of reptiles in the field, and studying such literature as is available to me, it is evident that little attention has been paid to the morphological characters of the hemipenis of Indian reptiles in the fresh and everted condition. The study of breeding habits, like the study of any other aspect of animal life, always leads one into a maze of ramifications. At this point the student is confounded, for no matter which path he follows he must know, or try to know, the geography of the others as they are inseparably interconnected. After years of work in the field, I have found myself at this point. To study breeding without the study of the genitalia, mode of coitus in the different groups, and other aspects, seemed to me to be incomplete. The present paper has been born out of a desire to put on record my limited anatomical studies and observations. I fully realize that the subject, as I have presented it, is very incomplete and that there is much room for further study, but for lack of time and facilities I cannot pursue the subject further.

Many of the conclusions I have drawn may perhaps, at first sight, appear rather gratuitous, but in the absence of positive fact these were the only reasoned conclusions I could arrive at after

weighing each detail in all its aspects in relation to the animal behaviour and such field observations as were possible.

However, one point really emerges from this scrappy account, namely, that the study of the copulatory organs should be undertaken from specially prepared material and their structure studied in the fully everted position, and not merely described from material dissected out of old spirit specimens. Such descriptions, though they may be useful, leave much to be desired. Dissected-out preserved specimens do not lend themselves to accurate description, and give us no idea of the organs in the fully everted state, which, to my mind, is the more correct aspect. This point is clearly illustrated by a comparison of the photographs and drawings accompanying this article with those reproduced in the *Fauna* (22) and elsewhere. If this article only serves as a stimulant to some other student to pursue the subject more fully than I have been able to do, it will have served a useful purpose and justified its publication in spite of its shortcomings.

In my opinion the paired copulatory organs met with in snakes and lizards should be taken together as representing two halves of a *single organ* adapted to the anatomical structure and habits of such animals as possess them, and not as two distinct organs capable of operating independently of one another. The dual structure, besides forming a passage for the conduction of the seminal fluid, functions as an *internal* copulatory hold during coitus. This in itself appears to be a very significant point and accordingly I cannot accept the statement that only one-half of the organ is inserted at a time, for reasons which I have explained at length above.

There is definitely a possibility of utilizing the penial characters as a means of classification, particularly when dealing with families and genera, but its use for specification must be left for further investigation and comparison of especially prepared material. However, there is perhaps one serious difficulty to this form of specific classification, namely, How are we to assign females to their correct species? This difficulty was experienced by the Popes when dealing with the genus *Trimeresurus* and is repeated in the *Fauna* (22). One species of this genus, at least, rests on a single known female (*T. kanburiensis*)! The remainder were separated on penial characters. Although there may possibly be subtle characters observable in females, so far I have failed to record any with the limited material at my disposal. However, I feel that as this form of classification implies dissection of the specimens under investigation, it is very undesirable as it means the possible ruin of the specimens in the long run, more so as it would have to be applied to all material in existing collections, some of which are undoubtedly already in a precarious state of preservation due to long storage and frequent handling. Another point that militates against an accurate description of the female cloaca is its unstable condition owing to the physiological changes which take place from the active to the inactive periods of the gonads. Although similar changes take place in the males the hemipenes do not undergo any alteration in characters in or out of season.

A point worthy of mention in the study of the hemipenis in reptiles is the transition observable from the completely divided organ in snakes and lizards with its sulci to the single solid organ with its groove in Crocodiles and Chelonians to the completely tubular, erectile penis in the higher animals (Mammals). However, this point of the possible evolutionary aspect is beyond the scope of this paper.

#### APPENDIX.

*How to sex a snake:* Some snakes exhibit sexual dimorphism, but these instances are few, and are only recognised after long experience. The comparative difference in the length of the tail between the sexes is at times helpful but is not infallible. In males the area just below the vent is somewhat 'spongy' owing to the presence of the hemipenis, but in unpractised hands may lead to a mistaken determination. Pressure at the base of the tail may result in the eversion of the hemipenis, in such cases the evidence is conclusive. Apart from actual dessication, and the application of pressure, the only *sure* way of sexing a snake is as follows:

Having secured the head (if a living animal is being examined), push the anal shield forward (towards the head) and press on the tail between the 1st and 3rd caudal shields at the same time drawing them downwards. This procedure widens the opening of the vent and occasionally exposes the point at which the hemipenis is invaginated. The seat of the invagination is often marked by a slight discolouring at the point of retraction. This area may be greyish, blackish or purplish. With a blunt probe gently probe in the area; if a male the probe will sink into the reverted hemipenis to the full depth of the organ which is a sure sign of the animal's sex. It is obvious that this will not occur in females—the organs are absent. An ordinary match stick will serve the purpose of a probe if one is not available.

<sup>1</sup>*Methods used in preservation.* After killing the animal cut off the body a couple of inches or so above the vent, if the complete specimen is not required, or, keep the head with the tail for purposes of identification. Pressure applied an inch or so behind the vent, according to the size of the snake, will usually induce the eversion of one or both halves of the hemipenis. The firmer the pressure the better. In some snakes this procedure is a little more difficult than it appears. The next thing is to take a syringe with a hypodermic needle (No. 16 or 18) filled with 4% formalin and insert the needle at the base of the organ through the scales—the

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<sup>1</sup> I discussed, with Dr. H. R. Rishworth, O.B.E., F.R.C.S., D.Ph., J.P., C.B.E., the injection method adopted by me for obtaining the everted positions of my specimens; and he was of the opinion that as I did not inject the fluid into the arteries a certain amount of distortion may have taken place due to intracellular infiltration. This point did not strike me at the time, but is certainly one to be remembered in future. However, there are difficulties when not working under laboratory conditions and when time is a consideration in the field.

distance below the vent varies with the size of the organ, or if already everted, the degree to which it is everted. Pump in the liquid carefully till the greater part of the hemipenis is visible; now tie a loose knot around the base of the pedicil in readiness to be tightened as soon as the hemipenis is fully everted by a further injection of fluid. If it becomes necessary to fill the syringe once more before the operation is completed, do not remove the nozzle, the fewer the holes the better, or else the liquid oozes out before the organ sets. When the hemipenis is fully distended withdraw the needle carefully at the same time tightening the knot firmly to prevent escape of the liquid. A little practice is needed before success is achieved. It is advisable to add a little Bouin's fluid to the formalin as this helps to harden the tissues more rapidly. When the organ is fully distended coat the outside also with Bouin's fluid. Having got so far, put the specimen aside to harden before immersing it in formalin for final preservation. It must be carefully watched during fixing to see that there is no serious retraction. If necessary a little more fluid can be carefully injected.

The same end may be achieved by means of a blow-pipe but this method is not so satisfactory as the fluid process.

If the hemipenes do not evert by injection they may be carefully drawn out by means of a pair of forceps and the thumb kept pressed behind to prevent it retracting. When the organ has been partially drawn out in this way employ the injection method. Specimens preserved in this manner keep well. This method may of course be improved upon.

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## BUTTERFLIES OF KAIRA DISTRICT—A LIST.

BY

HERSCHEL C. ALDRICH, M.D.

There is no published list of butterflies for Kaira District. Such a list may be of some value in fixing more exactly the distribution and range of butterflies as a whole in western India. The list will also be of interest to anyone who may be collecting in this area.

The following lists have been published for the nearest areas or localities surrounding Kaira District:—

(1) Jodhpur and Mount Abu (the latter is 140 miles, in a direct line, north of Nadiad, the centre of Kaira District). By A. D. Macpherson, in the *Journal of the Bombay Nat. Hist. Soc.*, Vol. xxxii, No. 1 (1927). 63 species are listed.

(2) Mhow (200 miles east of Nadiad). By Swinhoe in the *Proceedings of the Zoological Society* for 1886.

(3) Konkan (the northern limits of this area are given as Surat which is about 100 miles directly south of Nadiad). By E. H. Aitken and E. Comber in the *Journal of the Bombay Nat. Hist. Soc.*, Vol. xv, No. 1 (1903). 130 species are listed.

(4) Kathiawar, with special reference to Bhavnagar State (Bhavnagar is 80 miles south-west of Nadiad). By A. H. Mosse in the *Journal of the Bombay Nat. Hist. Soc.*, Vol. xxxiii, No. 4 (1928). 75 species are listed.

(5) Cutch (200 miles west of Nadiad). By C. G. Nurse in the *Journal of the Bombay Nat. Hist. Soc.*, Vol. xii (1900). 46 species are listed.

A comparison of these lists with ours for Kaira District is of special interest for the following species:—

*Colotis protractus* But. is not listed to the south-west in Bhavnagar, nor to the south in the Konkan. This would fix the south-western limit of this species along the coast of western India, in Kaira District.

*Neptis hylas varmona* M. is not listed to the south-west in Bhavnagar, nor to the west or north of Kaira District. The north-western limit of this species may be in the neighbourhood of Kaira District.

*Telchinia violoe*, Fab. is listed to the south-west and south of Kaira, but not to the west or north. The Kaira list may therefore fix its north-western coastal limit.

The butterflies here listed for Kaira District represent a collection made from December 1941 to December 1944. The collecting has been done fairly systematically and regularly by hand-net; no eggs or larvae have been collected. Most of the collecting has been in the centre of Kaira District, in and around Nadiad. The western half of the district has also been fairly well covered. The eastern half of the district has only been collected in spots and may produce a few more species. As no further new species have been added to our list during the past year, it is probable that this list

of fifty-nine different species includes all of the butterflies ordinarily found in the district. With more careful collecting the number of *Lycaenidae* and *Hesperiidae* might be increased. The nomenclature followed in our list is that of W. H. Evans in his book, *Identification of Indian Butterflies*, second edition revised. The numbers preceding each butterfly listed are those found in Evans' book, and are given for reference.

#### A. PAPILIONIDAE.

A2. 10.  $\beta$ . *Tros aristolochiae aristolochiae*, F. Fairly common in occurrence throughout the district.

A4. 1.  $\beta$ . *Papilio polymnester polymnester*, Cr. Rare. Two were seen in a garden in Nadiad on the 24th. of December 1944; one of these was collected; a male. This species is not listed to the north, west, or south-west of Kaira District. In all probability the north-western limit of this species along the coast of India is in Kaira District.

A4. 25.  $\angle$ . *Papilio polytes romulus*, Cr. Fairly common. The first or 'Typical Form' of female resembling hector, as described in Evens, is uncommon. The 'Second Form', resembling the male, has not been collected here in Kaira. The 'Third Form', resembling *aristolochiae*, is the common form of female seen.

A4. 27.  $\angle$ . *Papilio demoleus demoleus*, L. Common.

A6. 8.  $\angle$ . *Zetides agamemnon menides*, Fruh. Rare. During October and November a few are seen in gardens.

#### B. PIERIDAE.

B6. 3. *Deltias eucharis*, Drury. Fairly common.

B8. 1.  $\beta$ . *Belenois mesentina mesentina*, Cr. Common.

B9. 2.  $\angle$ . *Huphina nerissa evagete*, Cr. Common during October, November and December.

B10. 4.  $\angle$ . *Appias libythea libythea*, F. Not rare during November and December.

B11. 1. *Catopsilia crocale*, Cr. Common.

B11. 2. *Catopsilia pomona*, F. Common.

B11. 4. *Catopsilia pyranthe minna*, Herbst. Very common.

B11. 5. *Catopsilia florella gnoma*, F. Fairly common.

B15. 1. *Terias libythea* F. Fairly common.

B15. 2.  $\angle$ . *Terias laeta laeta*, Bdv. Common.

B15. 5. *Terias hecabe simulata*, M. Very common.

B17. 1. *Ixias marianne*, Cr. Common.

B18. 1.  $\beta$ . *Colotis amata amata*, F. Very common; especially along hedges of *Salvadora persica*. The next three species of *Colotis* are also found more frequently along hedges of *Salvadora persica*, or in the neighbourhood of this plant.

B18. 2. *Colotis protractus*, But. Rare; only found very locally on *Salvadora persica*, in one or two restricted areas in the south-west corner of the district. Collected in December and January. (See note in introduction on the distribution of this species.)

B18. 3. *Colotis vestalis*, But. Common.

B18. 4.  $\beta$ . *Colotis fausta fausta*, Oliv. Not rare.

B18. 5.  $\beta$ . *Colotis etrida etrida*, Bdv. Common.

B18. 7.  $\angle$ . *Colotis danae danae*, F. Common.



## C. DANAIDAE.

C2. 9. *Danais limniace mutina*, Fruh. Fairly common during the rains; rarely seen after October.

C2. 12. *Danais plexippus*, L. Rare; seen occasionally in some years only, during August and September.

C2. 15. *Danais chrysippus*, L. Very common; this is one of the commonest butterflies seen throughout the year.

C3. 7.  $\beta$ . *Euploea core core*, Cr. Common during the rains. The first are seen towards the end of July; they are common throughout August and September, and become scarce in October.

## D. SATYRIDAE.

D22. 1. *Melanitis leda ismene*, Cr. Rather scarce. A few are to be seen during September, October, November and December. Commonest perhaps in October.

## F. NYMPHALIDAE.

F1. 7.  $\beta$ . *Charaxes fabius fabius*, F. Rare. One ♀ collected 6-3-45. This is the only specimen seen or collected by me in Kaira District.

F26. 6.  $\angle$ . *Neptis hylas varmona*, M. Rare; only seen on one occasion early in November 1943. At this time seven specimens were seen, of which four were collected. (See note in introduction to this list, on distribution of this species.)

F30. 1. *Hypolimnas misippus*, L. Fairly common.

F30. 2. *Hypolimnas bolina*, L. Rather scarce; seen during September, October, and November. Very quick to take cover if molested. Females predominate; have only seen one male of this species in the district.

F35. 1.  $\angle$ . *Precis hierta hierta*, F. Rather scarce and somewhat local in its distribution. Seen in October and November.

F35. 2.  $\angle$ . *Precis orithya swinhoi*, But. Very common.

F35. 3.  $\angle$ . *Precis lemonias vaisya*, Fruh. Common.

F35. 4.  $\angle$ . *Precis almana almana*, L. Common in October.

F36. 1. *Vanessa cardui*, L. Common.

F52. *Telchinia violae*, Fab. Rare; seen in fairly large numbers, locally in south west corner of the district on Indigofera during September in 1943 only. One freshly emerged specimen collected Feb. 8, 1944, and one December 13, 1944. The rainfall in Gujerat has varied a good deal in the past four or five years. Up till 1943 it had been well below average for some four years. (See note in introduction on the distribution of this species.)

## H. LYCAENIDAE.

H12. 6. *Tarucus extricatus*, But. Not rare.

H13. 1. *Syntarucus plinius*, F. Common.

H14. 1. *Azanus ubaldus*, Cr. Common.

H14. 2. *Azanus uranus*, But. Common.

H14. 4. *Azanus jesus gamra*, Led. Not rare.

H23. 1.  $\angle$ . *Chilades laius laius*, Cr. Common.

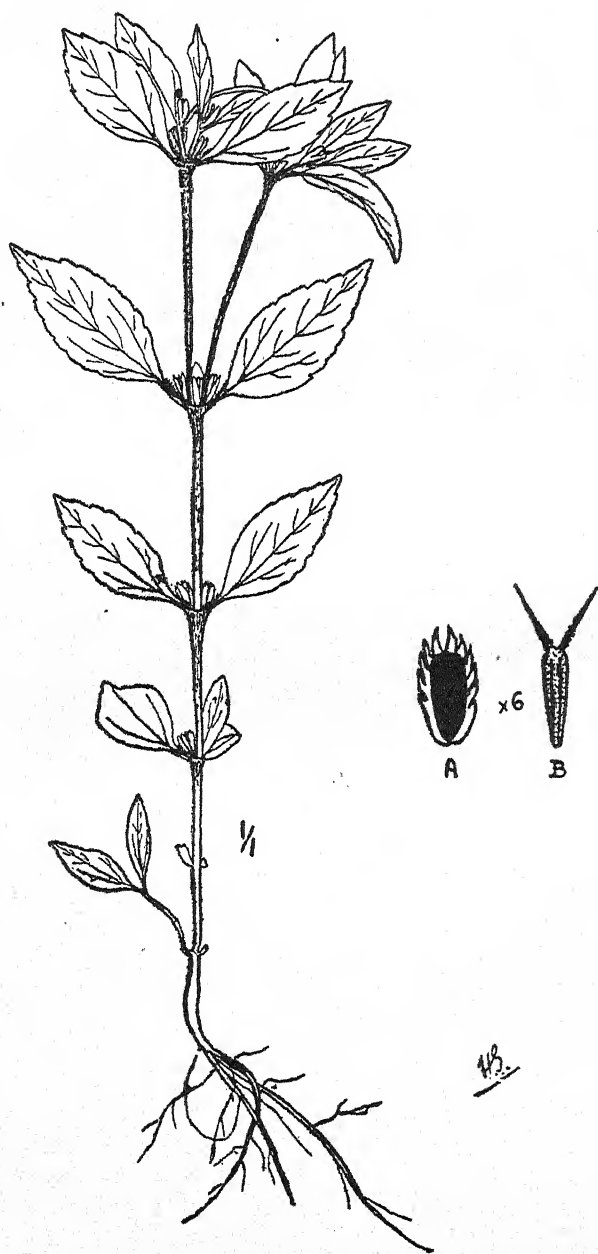
H24. 1.  $\angle$ . *Zizeeria trochilus, putii*, Koll. Common.

H24. 4. *Zizeeria lysimon*, Hub. Common.

H24. 6.  $\angle$ . *Zizeeria otis decreta*, But. Common.

H25. 1. *Euchrysops cnejus*, F. Common.





*Synedrella nodiflora* Gaertn.

A. achene of ray floret; B. achene of disc floret.

- H25. 2. *β. Euchrysops contracta contracta*, But. Common.  
 H27. 1. *Catachrysops strabo*, F. Common.  
 H28. 1. *Lamplides boeticus*, L. Common.  
 H29. 1. *ℳ. Jamides bochus bochus*, Cr. Not rare.  
 H57. 6. *β. Spindasis ictis ictis*, Hew. Not rare; seen commonly in November.  
 H84. 1. *Virachola isocrates*, F. Not rare. Locally distributed.  
 H85. 16. *Rapala melampus*, Cr. Rare. Only three seen; two of which were caught. (18 Dec. 1943, 28 Nov. 1944, and 14 Dec. 1944).

## I. HESPERIIDAE.

- I1. 16. *Hasora aloxis aloxis*, F. Rare.  
 I97. 24. *ℳ. Baoris conjuncta narooa*, M. Rare.  
 I97. 31. *β. Baoris mathias mathias*, F. Common.  
 I98. 1. *β. Gegenes nostrodamus karsana*, M. Scarce.

Nadiad,  
 Kaira District.  
 Dec. 1, 1944.

NEW PLANT RECORDS FOR THE PRESIDENCY  
OF BOMBAY (II).

BY

FR. H. SANTAPAU, S.J.

(With a plate)

In this second set of New Records,<sup>1</sup> I have selected mainly a number of plants from N. Kanara. For the description of the plants, I have consulted Hooker's *Flora of British India*, D Candole's *Prodromus*, Gamble's *Flora of the Presidency of Madras*, and, in the case of *Gomphostemma Heyneanum* Wall, Mukerjee's *Labiatae of the Indian Empire*. Their descriptions have been supplemented from study of the specimens in Blatter Herbarium.

1. *Synedrella nodiflora* Gaertn. *Fruct.*, ii, 456, t. 171, f. 7; D C. *Prodr.*, v, 629; Hook., *Exot. Fl.*, t. 60; Clarke, *Comp. Ind.*, 139; Hooker, *f. Fl. Brit. Ind.*, iii, 308; Gamble, *Fl. Pres. Madr.* 708; Mayuranathan, *Fl. Plants Madr., City*, 153.

*Synedrella* belongs to the family *Compositae*, and is placed by Hooker under Tribe V *Helianthoideae*, subtribe 6 *Coreopsideae*.

Annual, erect herb, branching dichotomously and reaching a height of about 60 cm.; stems and branches finely striate, terete, glabrous or more or less hairy with whitish appressed hairs, which are more dense just below the nodes.

<sup>1</sup> See J., B.N.H.S., vol. 45, p. 445.

Leaves opposite, ovate-lanceolate, tapering at both ends, serrate or crenate, scaberulous with a few scattered hairs on both sides; base decurrent into the petiole; petioles about 8 mm. long, but often obscure on account of the decurrent leaf blade. Nerves 3 from the base or near it, with about 4—6 pairs of fainter ones higher up. The bases of the petioles of opposite leaves meet round the stem and form a sort of a stipular cup, which is densely hairy with stiff white hairs and ciliate.

Involucres ovoid; bracts few, the outermost herbaceous, densely hairy; the inner ones passing gradually into the paleae of the receptacle, shining, yellowish. Receptacle small, flat. Floral heads in the axils of leaves, at the nodes between two dichotomous branches and at the end of the branches, sessile or nearly so, a few heads generally crowded together.

Florets yellow; outer florets ligulate, fertile, female, ligule short, broad, 2-3-toothed; disc florets hermaphrodite, fertile, tubular, limb 4-toothed. Both ligulate and tubular florets are of about the same size, so that the ligules are easily missed. Anthers black, subentire at the base, half-exserted. Style arms of hermaphrodite florets with long acute tips.

Achenes of ray florets dorsally compressed, 2-winged, smooth, wings irregularly cut unto a number of teeth which are hairy or pubescent (see plate, fig. A.); the achenes are black, the wings and teeth greenish yellow. Achenes of the disc florets narrower, striate, muricate, ending in two stiff, spreading hairy spines, which are as long as or a little shorter than the achenes (see plate, fig. B.)

This seems to be a Central American plant, which has been introduced into India in cultivated lands. Gamble, loc. cit., gives it as a plant of 'Plains Districts, occasional on cultivated lands, introduced from Mexico'. Mayuranathan, loc. cit., mentions that 'this weed is thoroughly naturalized here and is frequently found on waste land'. I have been unable to find any other reference to the plant in any other published floras on India.

In the Blatter Herbarium there is a specimen collected by Sedgwick (Sedg. 2952!) during September 1917 at Belgaum; a note in the handwriting of Sedgwick mentions that the plant is 'well established at Belgaum in the Fort and in compounds'. Recently I found this plant growing abundantly at Jogeshwari near Bombay (Santapau 8161, 8162); it was a gregarious plant, generally growing under the shade of trees, though it seemed to thrive best at some distance from the trunk of the protecting tree. (See pl.).

2. *Salomonina oblongifolia* DC. *Prodr.*, i 354; Bennett in Hooker f. *Fl. Brit. Ind.*, i, 207, *S. obovata* Wight Ill., i, 49, t. 22 B; *S. leptostachya* Wall. Cat. 4193.

*Salomonina* belongs to the family *Polygalaceae*; Cooke mentions only *Polygala*, Blatter in his Revision (Part XII, in this *Journal*, vol. 34, No. 2, p. 302, July 15, 1930) adds a new genus, *Xanthophyllum*. I add the genus *Salomonina*, which on the testimony of T.R.D. Bell is common in N. Kanara.

Simple or branched annual herb. Stems erect, glabrous, furrowed and slightly winged, 6-30 cm. high.

Leaves elliptic or ovate-lanceolate, sessile or very shortly petiolate, base acute not cordate, margins entire and with a few long distant hairs; mid-nerve strong, other nerves obscure. Stipules O.

Flowers minute in dense terminal spikes; bracts linear, minute, often persistent at the time of flowering. Flowers crowded, minute, 2-3 mm. in length, generally pink, occasionally white (Blatt. Herb. No. 35146). Spikes 1.5-4 cm. long.

Sepals 5, nearly equal, lanceolate, slightly ciliate, the 2 interior somewhat larger. Petals 3, united below with the staminal tube, the inferior petal keel-shaped, galeate, not crested; lateral petals much shorter than the keel. Stamens 4-5, filaments united below into a tube or sheath; anthers opening by pores. Ovary 2-celled, each cell with one pendulous ovule. Capsule much compressed laterally, 2-celled, loculicidal, margins with a row of long teeth, which are red or reddish in colour. Seeds albuminous, black, shining, not strophiolate.

This species is very near *S. ciliata* DC., from which it differs mainly in the shape and structure of the leaves; in *S. ciliata* leaves are amplexicaul, cordate, sessile and strongly ciliate.

To the localities given in *Fl. Br. Ind.*, North Kanara must be added. In the Blatter Herbarium there are several specimens collected during the month of October 1919 in various places of North Kanara: Hallb. and McCann, 35083, Jod-Siddhapur; 35146, Sampakhand; T.R.D.Bell, 4234, grass lands at Sulgeri on the Kala Nadi; L. J. Sedgwick 6656, grass banks by the sea, Karwar; Sedgwick and Bell 7254, Siddhapur. All these specimens show flowers and fruits; the upper part of the spikes is in flower, the lower in fruit, and most of the fruits are dehiscent.

3. **Gomphostemma Heyneanum** Wall. Cat. 2152/I and 2152/B; DC. *Prodr.*, xii, 551; Wight  *Ic. t.* 1456; Prain in *Ann. R.B.G.Cal.*, iii, 248 and t. 79; Gamble, *Fl. Madr.*, 1157; Mukerjee, *Lab. Ind. Emp.*, *Rec. Bot. Surv. Ind.*, xiv, 206; *G. strobilinum* var. *Heyneana* Hook. f. *Fl. Brit. Ind.*, iv, 696.

*Gomphostemma* belongs to the family *Labiatae*, and is placed by Mukerjee in Tribe VI, *Prasieae*. The following description is taken from Mukerjee, loc. cit.:

'Tall robust subshrubby herb, 60-100 cm. high; stem erect, obtusely tetraginous, slightly grooved, densely tomentose with stellate hairs. Leaves petiolate, elliptic-ovate, subacute, closely serrate, base abruptly cuneate and decurring on the petiole; lamina 16-24 cm. long, slightly rugose and shortly hirsute above, flocculently tomentose beneath; petiole 4 cm. long. Spikes terminal, interrupted near the base; bracts ovate or ovate-lanceolate, acute, rounded at the base, longer than the calyx; bracteoles linear. Calyx about 11 mm. long, teeth shorter than the tube, lanceolate, acuminate. Corolla yellow or blue with purple tinge, 12-15 mm. long, tube as long as the calyx, slightly incurved above, hirsute in the middle within; mouth broad, upper lip short, tomentose. Style glabrous. Nutlets 5 mm. long, black, rugose, glabrous.'

In the Blatter Herbarium there are several specimens of this plant, all of which have been collected in North Kanara round about Gersoppa Falls; No. 35076 was collected by Hallberg and

McCann in October 1919; Sedgwick collected Nos. 7062 and 7235/I, 7235/II, 7235/III in October 1918. All these Herbarium sheets bear remarks by the collectors showing that in every case the flowers were bright yellow. Prain, loc. cit., gives Stocks as the authority stating that the plant is found in the Konkan; I have been unable to trace this reference; neither Hooker f. nor Mukerjee mention Stocks as having found the plant in the Konkan; there are no specimens from the Konkan in Blatter Herbarium.

For a fine plate of this plant, see Prain, loc. cit., plate no. 79.

4. **Euphorbia prostrata** Ait. *Hort. Kew.* ii, 139; Hooker f. *Fl. Br. Ind.*, v, 266C not *E. prostrata* Grah., which is a synonym for *E. thymifolia* Burm).

J. D. Hooker in his *Fl. Brit. Ind.*, loc. cit., places this species at the end of his Euphorbias, under the heading 'Doubtful Species'. He adds the following remarks: 'Englemann (in Torrey, *Bot. Mex. Bound. Exped.*) says of this American species that it is found in India; but I have seen no specimen, nor does Boissier, who figures it well (*Euphorb.* Ic. t. 17), mention it as Indian. It is a native of W. Africa and the Mauritius. It closely resembles *E. microphylla*, differing in the ciliate keel of the cocci.'

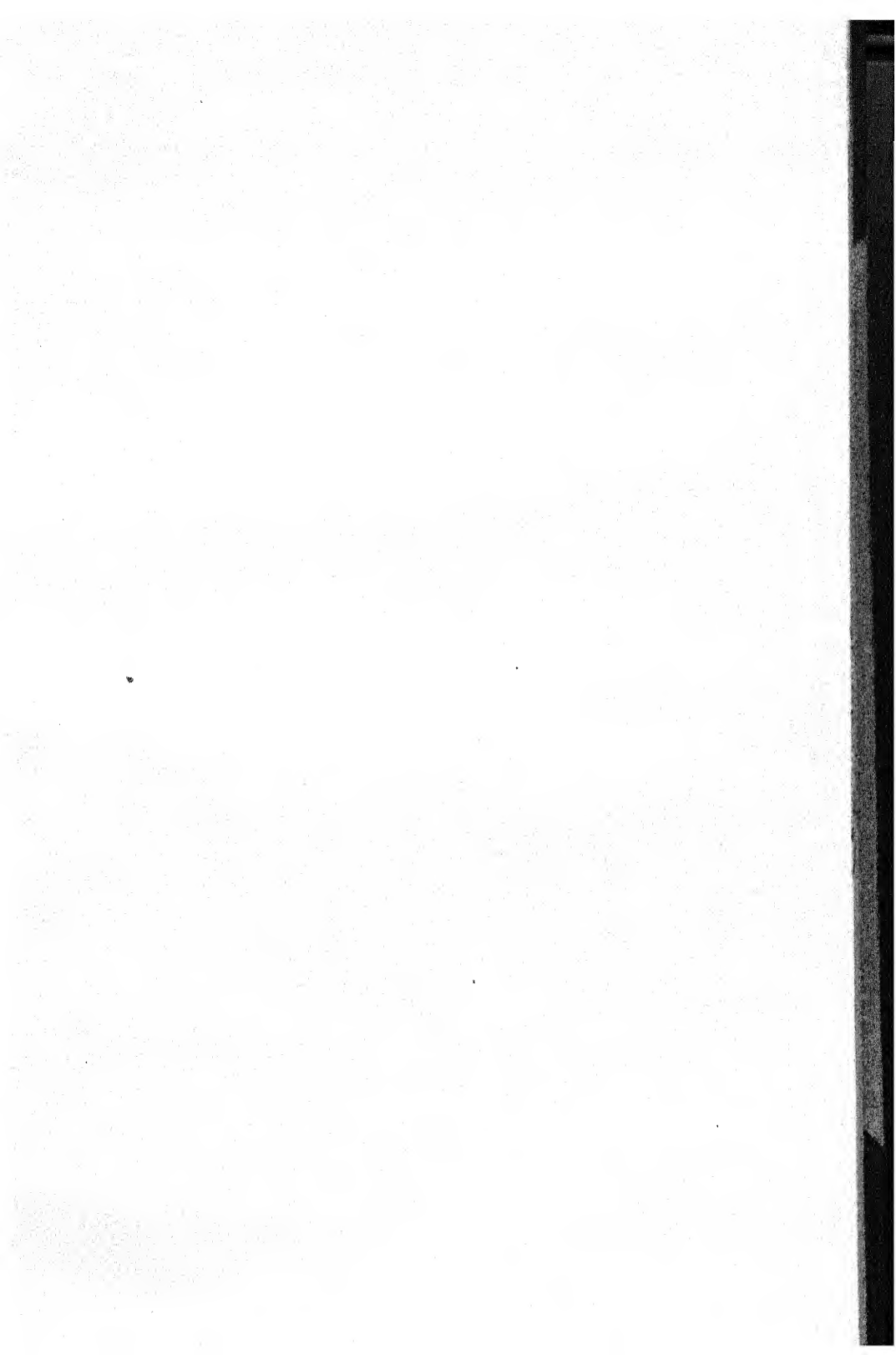
In Blatter Herbarium there are three specimens collected by M. Ezechiel at Poona on the 17th and 21st of May 1917 and identified by the collector as *E. thymifolia* Burm.; the identification of these three specimens (13509, 13509/B, 13510) has been corrected by Blatter, who adds the following remarks: 'Cocci ciliate especially the keels'. Gamble, *Fl. Pres. Madr.*, p. 1276, notes: '*Euphorbia prostrata* Ait. . . . Deccan and Carnatic, occasionally, usually probably as a weed in gardens. An introduced plant, native of W. Indies. A Prostrate herb.' On the evidence of Gamble and of the specimens in Blatter Herbarium, there is, therefore, no doubt as to the occurrence of this plant in India in general and in Bombay Presidency in particular.

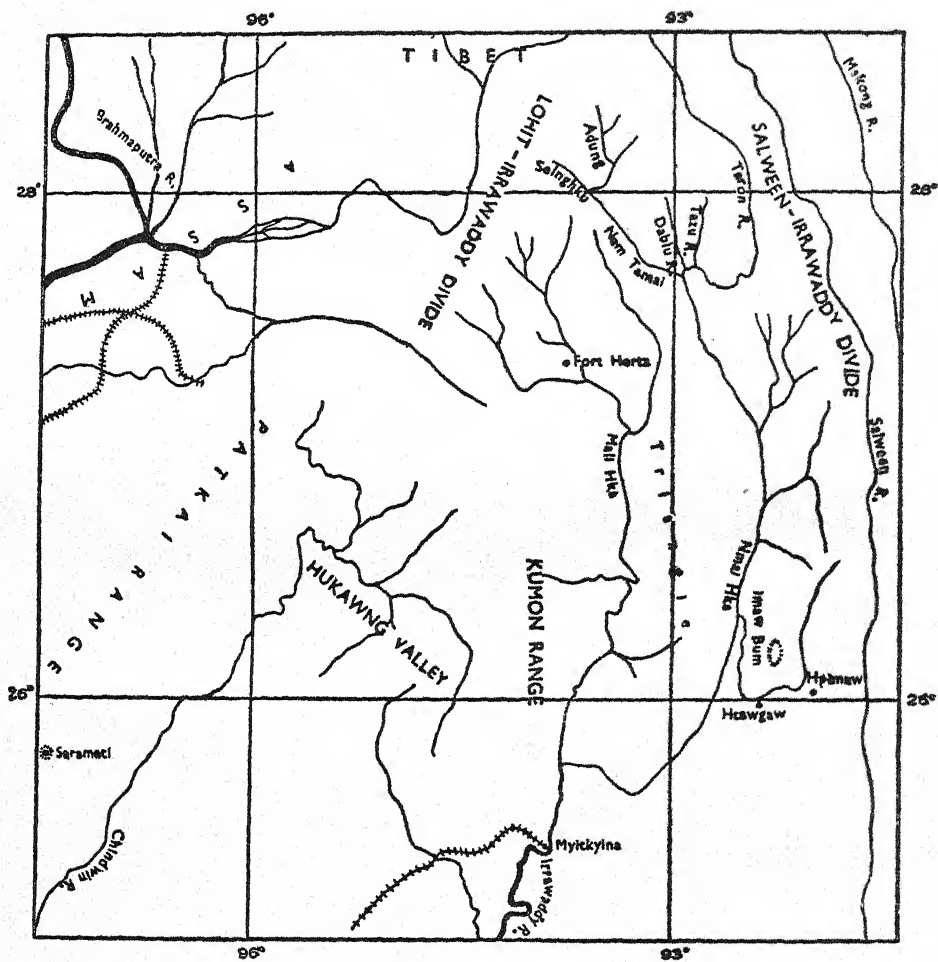
5. **Isanthera permollis** Nees in *Trans. Linn. Soc.*, xvii, 82; DC. *Prodr.*, ix, 279; Wight Ic. t. 1355; Clarke in *Hooker's Fl. Brit. Ind.*, iv, 372.

This plant belongs to the family *Gesneraceae*.

Small undershrubs; stems in the Kanara specimens 10-20 cm. high, up to 6 mm. thick, woody, covered with leaf scars almost from the base. Leaves alternate, broadly oblanceolate, tapering at both ends, entire or nearly so, with slightly revolute margins; up to 15 x 6 cm.; base decurrent into the petiole; petioles 0.6-3 cm. long. Nerves about 12-14 pairs, very distinct on the under surface of the leaves. Leaves, when young, densely silky pubescent with reddish hairs; at length glabrous or nearly so above, more or less pubescent beneath. Inflorescence cymose, axillary, towards the end of the stem; whole inflorescence densely silky pubescent, at length more or less glabrous. Peduncles about as long as the petioles, the whole cyme 1.5-4.5 cm. in diam. Bracts narrow, acute, up to 9 mm. long. Sepals 5, small, narrow, 4-6 mm. long, silky, at length glabrous. Corolla small, shortly campanulate, obscurely 2-lipped; lobes 5, ovate, white. Stamens 4, fertile; filaments short, anthers small, subquadrate, 2-celled, slits marginal, finally confluent at the submarginate apex. Disc very small or O.







Map of Upper Burma.

Ovary ovoid, sessile; style shorter than the ovary, stigma small, simple, ovary glabrous, muriculate.

Fruit a berry, small ovoid, 8×4 mm., fleshy, indehiscent. Seeds very small, ellipsoid, smooth, brown in colour.

Collected by Hallberg and McCann near Gersoppa Falls, North Kanara in October 1919 (Nos. 34758, 35050, 35053). Sedgwick and Bell collected it in the same month and year at Malemane Ghat in North Kanara (Nos. 7208/I, 7208/II).

6. *Microcarpaea muscosa* Br. *Prodr.* 436; Benth, in DC. *Prodr.*, x, 433; Gamble, *Fl. Pres. Madr.*, 963; Hooker in *Fl. Brit. Ind.* iv, 286.

This plant belongs to the family *Scrophulariaceae*, and the genus is not mentioned in Cooke as occurring in the Presidency.

A very small slender, diffuse or creeping nearly glabrous herb. Stems tufted and interlaced, 6-12 cm. long, rooting at the nodes, angles of the stem and calyx sometimes ciliate.

Leaves opposite, sessile, oblong, obtuse, entire, 3-8 mm. long. Flowers minute, axillary, solitary, sessile, ebracteate, in one axil only of each pair of leaves, about 2-3 mm. long. Calyx tubular 5-angled, 5-fid. Corolla very short, tube broad; lobes 5, spreading, the 2 upper lobes subconnate; tube shorter than the calyx. Stamens 2 perfect, filaments filiform; anthers confluent, 1-celled; staminodes 0. Style filiform, stigma capitate, recurved. Capsule minute, included, ovoid, 2-grooved, loculicidal; valves entire, separating from the placentiferous septum. Seeds few, ovoid.

To the localities given in Hooker's Flora must be added those given by Gamble: 'W. Coast, S. Canara to Travancore in marshy places.' In the Blatter Herbarium I have seen the following specimens: No. 34345, collected by Hallberg and McCann at Karwar, N. Kanara during the month of October 1919; Sedgwick 5123, collected by Sedgwick in a rice field at Karwar in December 1918, and Sedg. 7256 collected by Sedgwick and Bell at Siddhapur in October 1919. These three specimens constitute a new record for the Presidency.

## ADDITIONAL NOTES ON THE BOTANY OF NORTH BURMA.

BY

F. KINGDON WARD, B.A., F.L.S., etc.

(With a map.)

Recently I received from Mr. E. J. H. Corner, Assistant Director of the Singapore Botanic Garden, the Burma diaries which I left there in 1941. Mr. Corner was a prisoner of war throughout the Japanese occupation, but had persuaded the Japanese of the importance of keeping up the Gardens; with the result that not only was he himself in some measure retained to help Professor Tanakadate—appointed by Tokyo University to the Directorship—but

he succeeded in saving the herbarium and library both at the Gardens and the Raffles Museum, for which men of science all over the world will ever be grateful. Professor Tanakadate, convinced by Mr. Corner that my diaries were harmless and of some scientific value, agreed to their preservation in the library where Mr. Corner hid them; thus to him also, as well as to the foresight, courage and ingenuity of Mr. Corner, I am indebted for the preservation of what, for me, was irreplaceable. Soon after his release, and before leaving India for England, Mr. Corner posted the diaries to me. As a result I am now able to add considerably to my Sketch of the Botany of North Burma (*J.B.N.H.S.*, Vols. 44, 45) which was written largely from memory and rough notes after I left Singapore in 1941.

Mr. Corner is, I believe, still in England but hopes to return to Singapore shortly. His many friends will wish him luck and many years of health and happiness to carry on the work which he so gallantly stuck to.

#### TROPICAL EVERGREEN RAIN FOREST (500-2,000 ft.).

The Myitkyina plain, where not cultivated, has been cleared of jungle and in many parts has suffered from over-grazing to such an extent that the dwarf *Phoenix humilis* is almost the only plant which will grow on the hungry ground. Elsewhere are thickets with a great variety of shrubs—forerunners perhaps of the regenerating forest—herbaceous plants like *Amorphophallus Cruddasiana* and climbers both woody and herbaceous; *Rorana*, *Argyrea*, and other *Convolvulaceae*, *Thunbergia*, *Mussaenda*, and many others. *Tectona grandis* also grows round Myitkyina, but not it seems further north. Many trees are planted, including a fair number of local species such as *Mesua ferrea*, *Aesculus assamica*, species of *Cassia*, etc. Ascending from the Myitkyina plain to the alpine region, two of the major changes of vegetation are accompanied by an abrupt change in the number of species. The first change occurs at about 9,000-10,000 ft. with the passage from Temperate Forest to *Abies* Forest, accompanied by a distinct drop in the number of species; the second at about 11,000-12,000 ft. with the passage from forest to alpine vegetation, accompanied by an increase in the number of species.

In the Tropical Evergreen Rain Forest, plank buttress roots, though they are sometimes seen (e.g. *Ficus glomerata*) are not common. Cauliflory, also typical of the Malaysian jungle and common amongst the Figs of North Burma, is not otherwise conspicuous (e.g. *Mayodendron igneum*).

A species of *Dipterocarpus* taller than the average tree, which is common in the valley of the Eastern Irrawaddy (Nmai Hka), is probably *D. turbinatus*; while all the way up the Mali valley occurs what seems to be *D. alatus*. Nor is there anything strange in the two valleys having different species. There are factors influencing the flora of the eastern valley which do not operate in the western. (1) The proximity of high mountains coupled

with the fact that the Sino-Burma frontier ranges were glaciated down to 26 N. lat. and further East to 25°. (2) The proximity of the Eastern Asiatic flora.

Other trees noted in this zone are: *Altingia excelsa*, *Aesculus assamica*, *Hibiscus macrophyllus*, *Betula cylindrostachya*, *Cedrela Toona*, *Sterculia villosa*, *S. colorata*, *S. acerifolium* the three last-mentioned all flowering in the hot weather, *Ficus obtusiloba*, species of *Engelhardtia*, *Acer*, *Lagerstroemia*, *Ulmus*, *Mangifera*, *Nephelium*, *Milletia*, *Garcinia*: several of these become more prominent in the next zone.

Perhaps 10% of the trees in the narrow Nmai valley on the hot sandy banks are leafless for a short time in the hot weather. In April I noticed *Gmelina arborea*, *Bauhinia variegata*, *Stereospermum chelonoides*, *Sterculia villosa*, and *S. colorata*, *Erythrina*, *Albizia* spp. *Ficus* spp. and *Cassia nodosa* (?) bare.

Above the confluence there is shifting cultivation even so low as 1,500 ft. and big clumps of *Dendrocalamus Hamiltonii* are a feature, perhaps planted, or owing their presence to burning of the jungle. At any rate it is a plant which seems to thrive where the jungle has been cleared. This species had flowered everywhere in North Burma in 1937 or 1938 and, all or nearly all, the plants were dead. Patches of bamboo forest—not the *Dendrocalamus*—also seem to result from repeated burnings; these of course are easy to cut and burn again, but they probably indicate a soil well on the way to exhaustion. A tangle of big climbing plants is also quickly in evidence, notably *Thunbergia grandiflora*, *T. coccinea*, *Mucuna pruriens* *Uncaria pilosa* and *Pueraria*. Tall grasses are good indicators of the same process and suggest an impoverished or badly leached soil; *Imperata* and two other grass species (*Saccharum*?), with the fern *Gleichenia* also suggest a hungry soil. Early comers—this before the clearings go over completely to bamboo or grass—are *Ficus cunia* and other species, *Hibiscus macrophyllus*, *Callicarpa arborea*, *Macaranga* sp. From the outside the forest seems to be completely draped with large sprawling creepers which hang almost to the ground in endless festoons and curtains, but from within nothing is visible except innumerable cords, ribbons, and corkscrews disappearing into the semi-darkness above. Besides those previously mentioned we may note: *Entada scandens*, *Securidaca tavoyana*, *Vitis angustifolia* and *V. lanceolaria*, *Calamus* (a few species) *Dioscorea*, *Smilax* *Hoya*, *Illigera*, and various *Menispermaceae*. On the tree trunks many root climbers find support as for example *Raphidophora*, *Pothos*, *Freycinetia*, *Piper*, and *Ficus*. Epiphytes include a few orchids like *Cymbidium* and *Dendrobium* and the fern *Drynaria*. The commonest epiphytic fern, probably *Platynerium Wallichii*, Bedome records as occurring from the Malay Peninsula southwards. Owing to a combination of hot weather and drought in winter, tree ferns are rare, being more characteristic of the next zone.

The density of the jungle is largely due to undergrowth. Enough light penetrates between the trees to encourage a thick

growth of shrubs and herbs including bamboos. There are also open spaces with tall grasses and shrubs—*Mallotus philippinensis*, *Maesa*, *Jasminum*, *Crotalaria*, *Rhynchoctechum* and others; in damp places are seen *Phlogacanthus curviflorus*, *Hedychium*, *Lasia aculeata*, *Jussiaea*, and various small *Comellinaceae*, *Cyperaceae*, etc.

A sere sometimes seen on dry rocky slopes where the soil is obviously poor comprises small trees and saplings of various species, including *Litsaea* and *Dracaena*; no undergrowth.

The most interesting sere in this lowest zone however is that in the river bed. In the shrub barrage at the top of the sand bank close to high water mark, besides the shrubs previously mentioned are: *Photinia Benthiana*, *Flemingia macrophylla*, *Phyllanthus (Emblia) Griffithii*, *Ligustrum massalongianum*, *Ficus glomerata* and *F. hispida*, *Ardisia pedunculata*, species of *Cinnamomum*, *Boehmeria*, *Saurauja*. Lower down in the riverbed where there is shingle *Pourthidea arguta*, *Homonoia riparia*, *Salix tetrasperma*, and the Rose previously mentioned are all submerged for a shorter or longer period. Where there is more sand, the fern *Goniopteris prolifera* is common, its runners many feet in length. *Grewia laevigata* is another plant which can withstand submergence, as can *Ficus pyriformis* found on rocks. Most of the strand plants mentioned occur up to 3,000 ft.; some up to 5,000 ft. e.g. in the Ngawchang valley. I have made no attempt to distinguish between tropical evergreen and subtropical hill jungle, so far as these seres are concerned. All the shrubs of the barrage have close growing interlacing stems which help to hold up floating vegetable debris and increase the humus in the soil. They have tremendous root systems to anchor themselves firmly against the current.

#### SUB-TROPICAL HILL JUNGLE (1,500-5,500 ft.).

As previously pointed out there is a difference between tropical rain forest at 2,000 ft. immediately above the Myitkyina plain, and the similar looking jungle 100 miles further north close to the high ranges, as for example, in the Nmai valley. The same is even more true of the next zone. In the neighbourhood of the snows, plants which occur—if at all—only above 5,000-6,000 ft. in the south, are met with at 4,000 ft. north of Fort Hertz. In other words there is a progressive lowering of the zones as you proceed north to the extent of 1,000-2,000 ft.—with however a difference. At the Seinghku-Adung confluence in lat. 28° Temperate Rain Forest begins at 4,000 ft. and Temperate Pine Forest at 4,500 ft. So also with Sub-Tropical Hill Jungle.

Additional characteristic, though not exclusively, hill jungle trees are: *Acer Campbellii*, *Lagerstroemia parviflora*, *Fagracea obovata*, *Pithecolobium angulatum*, *Lonicera ovata* (in flower in July), *Castanopsis tribuloides*, *Ficus Roxburghii*, *F. bhutanica*, *F. nervosa*, (which starts as an epiphyte) *Quercus zyllocarpa*, *Q. Thomsoni*, *Q. fenestrata*, *Q. lamellosa*, *Meloderum rubiginosum*, *Schima Wallichii*, *Saurauja fasciculata*, *S. napaulensis*, *Emblia officinalis*,

*Magnolia Griffithii*, *Croton caudatus*, and species of *Sapium*, *Machilus*, *Dysoxylum*.

I have mentioned earlier that many trees common in the Tropical Evergreen Rain Forest ascend into the hill jungle sometimes to 5,000 ft. and that no sharp line of demarcation separates the two. Why then, it may be asked, attempt to distinguish between them? The answer is that did we not do so we should be for ever trying to analyse the first 6,000 ft. of jungle into simpler parts—and at top levels the hill jungle differs widely from the luxuriant tropical forest of the damp shady valleys; some division there must be to satisfy the urge to simplify which seems to be inherent in us. The one put forward seems reasonable, but it may not be the best possible.

The more or less arbitrary contour of 2,000 ft. as the lower limit of the hill jungle corresponds with an increase in the number of epiphytes, a decrease in the number and variety of strangling figs, an increase in the number and variety of *Lauraceae*, *Euphorbiaceae*, *Urticaceae*, *Acanthaceae*, (especially *Strobilanthes*) *Zingiberaceae* often gregarious, *Araliaceae*, and other families, and of bamboos. Separately these indications of a change in the vegetation do not amount to much; but taken together they add up to something. Besides *Bucklandia*, three other trees,—*Quercus pachyphylla*, *Rhododendron eriogynum*, and *R. stenaulum* mark where the hill jungle passes into Temperate Rain Forest, with a still larger assemblage of epiphytes. Also noticeable in the hill jungle is the emergence of a temperate herbaceous flora, as for example on roadside banks. In the valley of the Nam Tamai at an altitude of less than 4,000 ft. one comes suddenly on species of *Ranunculus*, *Thalictrum*, an *Umbellifer* with finely cut leaves, *Myosotis*, *Valeriana*, *Anemone vitifolia* *Parochetus communis* and of course species of *Hypericum* *Campanula* (*C. colorata*) *Lysimachia ramosa*, and *Viola*, nearly all of which are more or less ubiquitous in the tropics but none the less plants of the Temperate zone.

Then at the lower limit of the hill jungle we find such characteristic subtropical climbers as *Entada scandens* and big scramblers like *Acacia pennata* and *A. caesia*, etc. At higher altitudes scandent bamboos are seen.

There is plenty of room for small trees and shrubs, especially towards the upper limit of the zone and lining the river banks. Often the forest is not dense, and here along with many species of bamboo are shrubs and undershrubs e.g. *Rhynchosycheum*, *Polygala arillata*, *Osbeckia nepalensis*, *Clerodendron bracteatum*, *C. infortunatum*, small figs, *Eurya*, *Eugenia*, and others. There is also a considerable herbaceous undergrowth of *Marantaceae*, (*Stachyphrynium*) *Musa*, *Tacca laevis*, gregarious *Strobilanthes*, *Curculigo*, etc. Epiphytes include *Aeschynanthus grandiflora*, *Ficus nervosa* (which soon becomes an independent tree) *Loranthus* spp.

On roadside banks is found an unstable sere, the vegetation being constantly slashed and burnt. There is a good deal of moss in which many seedling trees come up; common plants are *Lysiotus*, *Solanum*, *Corydalis*, *Torenia*, *Colocasia* (a gregarious species),



*Polygonum capitatum*, *Pratia begoniifolia*, *Plectranthus Coelsa*, several *Selaginellas*. Between Fort Hertz and the Nam Tamai *Plectranthus macranthus* is common along the edge of the forest. A charming white flowered orchid, *Diplomeris pulchella* grows on rocks by the river.

But as previously remarked the most interesting sere is that found in the river bed. In the rocky bed of the Tamai between Pangnamdim and the Seinghku confluence at 3,000-4,000 ft. *Rhododendron Simsii* is still found occasionally. On rocks also are *Ficus pyriformis*, *Astilbe ricularis*; at high water mark in the sand *Neillia thyrsiflora*, and *Glochidion*, with *Equisetum*, ferns, grasses, *Thalictrum*, and *Viola*, but no rose. *Neillia thyrsiflora* really belongs to the next higher zone. Other commonly seen plants in the Tamai valley are *Costus speciosus* and *Leucospectrum canum*.

It is not possible in a short article to give more than a faint indication of this extensive flora; I have wherever possible called attention to such plants as I collected or could name; another botanist might produce a different list of names. But I have also tried to illustrate—and justify, the several climax formations I can recognise in North Burma.

#### SUB-TROPICAL PINE FOREST.

All the way up the Ngawchang valley between 5,000 and 6,000 ft. with Sub-Tropical Pine forest on one side and Temperate Pine Forest on the other (if sufficiently sheltered) the river banks are clothed with a great variety of trees, shrubs, and climbers both woody and herbaceous, amongst which occur the following: trees:—*Michelia lanuginosa* (replaced in the Adung valley by *M. Doltsoa*, with *Pinus excelsa*), *Ficus obscura*, *Juglans regia*, *Quercus glauca*, *Castanopsis indica*, *Manglietia insignis*, *Adinandra* (*A. Griffithii* ?) *Engelhardtia spicata*, and *Taxus* sp. the only other conifer. Shrubs:—*Viburnum stellulatum*, *Hypericum Hookerianum*, *Ilex corallina* and other species, *Oryzopora paniculata*, *Ficus lepidosa* and others, a second species of *Adinandra*, several species of *Rubus* (*R. lineatus* *R. rosaefolius* *R. ellipticus*), *Spiraea canescens*, and species of *Rhus*, *Ardisia*, *Leptodermis*, *Eurya*, *Derris*, *Gaultheria*, *Hydrangea*, several *Rhododendron*, etc. Amongst climbers may be mentioned *Leptocodon gracile*, *Stemona Wardii* (endemic), *Clematis Buchananiana* and *C. nepalensis*, *Heptapleurum venulosum*.

Other interesting plants are *Boenninghausenia albiflora* on turfey limestone ridges, *Primula densa* (endemic) also on limestone but in deep shade, *Prunus communis* on open hillsides, but seen only near villages so probably cultivated, *Cynoglossum amabile*, and on the bracken clad hills *Artemisia*, *Dipsacus*, *Swertia*. It may be noted that in the Adung Valley, with *Pinus excelsa* instead of *P. insularis*, *Primula dunicola* replaces *P. densa* just as *Michelia Doltsoa* replaces *M. lanuginosa*. The plant associations of the Ngawchang valley close to the Chinese frontier and isolated from the sub-tropical Nmai Hka by the high Pyepat ridge, are

more Chinese; those of the Adung valley, more Himalayan and Tibetan. Although 6,500 ft. has been taken as a convenient upper limit of Pine forest, both at Hpinnaw and at the Panwa Pass a few miles further south, Pines grow nearly a thousand feet higher, associated with *Rhododendron Delavayi* (a species very similar to *R. arboreum*), *Salix*, *Quercus Griffithii*, *Rosa sericea*. At the top level there is not much about the vegetation deserving the description sub-tropical, unless luxuriance and variety are to be regarded as characteristic sub-tropical features; they are not exclusively so. Variety of vegetative form there certainly is too—trees, shrubs, epiphytes, climbing plants, herbs; but most of the species have Temperate affinities, and the Sub-Tropical Pine Forest has already passed into mixed Temperate Forest (7000-9000 ft.) Below the Panwa Pass, where the ground is boggy we find *Primula helodoxa*, *Iris*, *Parnassia*, *Caltha palustris*, *Aconitum*, *Gentiana*, etc.

However *Pinus insularis* begins lower down than *P. excelsa*, where the vegetation deserves to be called sub-tropical, and does not ascend quite so high. It is therefore convenient to retain the name Sub-Tropical Pine forest for the present at any rate.

#### TEMPERATE RAIN FOREST.

Taking the entire zone from 5,000 to 8,000 ft. the Temperate Rain Forest is probably richer in species than any other zone of equal depth in North Burma. Many trees regarded as properly belonging to the sub-tropical hill jungle and pine forest actually extend far into the temperate zone; and as already pointed out it is impossible to draw any hard and fast line.

An abundant climber of the warmer levels around 5,000 ft. is *Streptolirion volubile*. Species of *Clematis*, of which there are several, include *C. Henryi* and *C. fasciculiflora*. Epiphytes include *Hymenodictyon parasiticus*, *Medinilla*, *Loranthus*.

Shrubs include *Caryopteris grata* and *Leycesteria glaucophylla*. Figs are in general much reduced in size, as well as in variety—*Ficus forcolata*, *F. nemoralis*, and the creeping *F. repens* occur.

In forested gullies where bamboo undergrowth (*Phyllostachys* and *Arundinaria*) is prevalent large colonies of *Urticaceae* are often conspicuous—generally some species of *Elatostema*.

In the cool temperate forest there is an increase in the number of *Acers*, and probably also of oaks and *Ilex*, as of *Rhododendron*. *Acer Hookeri*, *A. Campbellii*, *A. sikkimense*, (generally epiphytic) *Quercus lanuginosa* and *Q. Ilex* are a few. In the temperate pine forest we first meet with the *Shortia*-like *Berneuxia tibetica* (ascends to 9,000 ft.) of the climbing *Trychosanthes palmata* and of a large handsome yellow flowered *Clematis* with simple leaves, found in the Adung valley. The *Iris* previously referred to as *I. Milesii* is *I. Wattii*.

#### MIXED TEMPERATE FOREST.

*Juniperus Cozii* occurs locally. It is a big tree—endemic. *Taxus*, though scattered, is not rare; it extends to 10,000 ft. Another small tree found in this zone is *Magnolia nitida*; it is

apparently confined to the eastern ranges—I have never seen it in the Adung valley.

Between the Nam Tamai and the Tazu river the mountains are covered with Temperate Pine forest below and with *Abies* forest above; with nothing between. Along the 9,000-foot ridges a variety of shrubs—*Rhododendron Martinianum*, *R. triflorum*, *R. tephroleptum*, *R. megacalyx* *Enkianthus pauciflorus*, *Skimmia Laureola*, *Daphniphyllum*, *Cassiope*, *Vaccinium glauco-album*, *Clethra*, mark the beginning of silver fir forest. On rocks grow small *Liliaceae* (*Tofieldia*, *Smilacina*) *Coelogyne*, *Carex*, *Ophiopogon*, *Luzula*, and other plants; and under the bushes here I found *Cornus suecica* (now *Chamaepericlymenum suecicum*). A rough leaved *Begonia* with masses of small pink flowers is the only species of this genus to ascend above 7,000 ft. *Rhododendron crinigerum* and *R. oreotrephe*s, mixed with *R. arizelum* clothe some slopes where mixed Conifers meet Silver Fir.

*Chamaepericlymenum suecicum* is not, as previously stated, the only Arctic species in Sino-Himalya (of which alpine Burma forms a part); there are several others e.g. *Androsace Chamaejasme*. As far as broad leaved trees are concerned the Mixed Temperate forest consists very largely of *Rhododendrons* (about 20 species including epiphytes), oaks, *Ilex* spp. *Acers*, together with Birch, *Schima*, several *Magnoliaceae* and *Lauraceae* (the former very prominent), and a few *Araliaceae*. Both the species and the proportion of deciduous to evergreen differs widely on exposed ridges and on sheltered slopes. In fact at this altitude the exposed and sheltered flanks of a spur support entirely different formations; while the crest of the ridge is generally clothed with sub-alpine scrub differing only in composition from that found normally 2,000 ft. higher. Which shows how impossible it is to fit nature into a straight-jacket. Such scrub, growing along the windy spurs above the Nam Tamai, for example, and on the way to the Hipinaw Pass, is composed largely of small *Rhododendrons* mixed with *Arundinaria* and a variety of shrubs and stunted trees such as *Corylus ferox*, species of *Sorbus*, *Salix*, *Populus*, *Deutzia*, *Daphne*, *Cotoneaster*, *Berberis*, *Juniperus*, *Euonymus*, *Coriaria*, *Maesa*, *Eurya*, *Viburnum*, and others. But from 8,000 ft. upwards *Rhododendrons* are dominant along the rocky spurs. The Mixed Temperate Forest zone is as far as outposts of the true alpine flora have penetrated downwards—it marks, that is to say, the limit of their descent. These scouts, which are none too happy, it would seem as they survey their chances of survival in a clash with the Forest, colonise bare rocky outcrops, slips, gullies, screes clearings, whether natural or artificial—in fact any place where vacant possession can be temporarily obtained. A change of climate might of course confirm their hold,—or on the other hand, drive them out. In the Silver Fir Forest these intruders—and opportunities for their expansion—become more numerous.

In the Adung valley, *Primula sino-Listeri* is occasionally met with, on bare ground. Amongst Chinese *Rhododendrons* which, like *R. Delavayi*, cross into Burma along the frontier near the Panwa Pass are *R. sulfureum* and *R. yunnanense*.

As for Moss Forest, one finds that many of the epiphytic shrubs have drip-tip leaves, and at the opposite extreme are provided with water-storing tissue in the shape of swollen stems (e.g. *Agapetes*, *Vaccinium*)! Other epiphytes are filmy ferns growing in the moss, *Leucothoe*, *Polygonatum*. The habit is usually trailing, with long pendent branches.

#### SILVER FIR FOREST.

Epiphytic Rhododendrons include *R. bullatum* and *R. micromeres*, the former one of the most beautiful of all Rhododendrons, the latter one of the very few with repulsive small flowers of a muddy yellow. It however makes up for this lapse by the vermilion and gamboge colours of its leaves in winter. Trees include *R. fulvoides* and *R. gymnogynum*, the former with *R. Beesianum* towards the upper limit of the fir forest. The rather scrubby *Acer erosum* (not *A. candatum*) is found as high as 11,000 ft.: perhaps the last deciduous tree, other than Larch, unless some species of *Sorbus* ascend higher.

Another Chinese plant found in the upper Adung valley is *Primula lichiangensis* is found at 10,000 ft. *Nomocharis saluenensis* is scattered along grassy ridges in this zone, and *N. pardanthina* is associated with *Iris decora* on alluvial fans, but is less confined within limits than most species of the genus, being found between 8,000 and 12,000 ft. With these two grows *Aster fuscescens*. On a similar gravel chute I found a few plants in fruit only of what may have been *Cathcartia villosa* though at the time I took it for an unknown species of *Meconopsis*. It was growing in high meadow at over 10,000 ft. altitude above the Nam Tamai (1937). On rocks in the same gulley a charming dwarf *Allium* was in flower in September; and under the bushes was a single large clump of an unknown *Hypericum*. None of these plants have been raised from the seed I collected, and future explorers should look out for them. I came to the conclusion that there must be many unknown alpine and sub-alpine plants in North Burma waiting to be discovered.

Other plants of this zone are *Clintonia alpina* found under bushes, and yellow flowered *Helianthemum* on bare stony slips.

The plant referred to as *Iris Delavayi* in Part III is more likely *I. chrysographes*.

#### SUB-ALPINE SCRUB.

In this zone woody plants tend to occur in large colonies. Not only Rhododendrons and Birch grow gregariously, but also *Salix* (several species). More scattered shrubs include species of *Lonicera*. *Streptopus simplex* is common up to 12,000 ft. throughout the sub-alpine scrub. It has attractive lily-of-the-valley flowers, and an engaging fan-like habit.

Other alpine herbaceous plants are *Meconopsis impedita* (a red flowered form grows on rocks in the Seinghku valley); *M. integrifolia*, found only in the Seinghku valley where it is not common;

*Primula serratifolia*, often amongst *Arundinaria* but ascending to 14,000 ft.; and, in meadow, species of *Arisaema*, *Codonopsis*, *Adenophora*, *Delphinium*, and a variety of *Compositae*, *Umbelliferae*, etc. *Primula capitata* on screes, is a late flowering species.

#### ALPINE TURF AND SCREE.

Two species characteristic of this zone not previously mentioned are *Primula muscoides*; and *P. triloba*, both tufted mat plants. In boggy ground *Primula Dickiena* (Gamlang valley); *Gentiana grata*, and *G. stylophora*, both high alpine, *Oreosolen*, and *Picrorhiza*, the two last named genera peculiar to Sino-Himalaya also occur. *Lychnis nutans* grows on screes, and on turf slopes solid clumps of a fern, *Athyrium felix-foemina* are abundant, with clumps of *Iris Rumaonensis*.

## MISCELLANEOUS NOTES

### 1.—A TIGER CLIMBING A TREE.

I am enclosing two photographs showing a tree, up which a young tiger climbed and which incident is most interesting and probably unique in the history of such animals. The tree is a soft-skinned one, commonly met with in the forests of the Khasi and Jaintiah Hills of Assam. The total height of the tree is about 80 feet and the first branch springs from the stem at about 45 feet. The girth at the bottom is about 9 feet. The cub was lying flat on one of the branches about 15 feet higher than the first branch, and was fired at with a shot gun by a local Garo who wounded the animal in the first shot and then whilst the animal was coming down backwards, he fired a ball cartridge at it but apparently missed. The tiger jumped off the tree and made away into the jungle, with a blood trail going for quite a long distance. My brother, who is a forest officer, and I verified the statement by examining the tree and the trail of blood. From the size of the pug marks and the claw marks up the tree, it was quite obvious that they were those of a tiger cub; probably driven up the tree by wild dogs or its parent as the parents were seen by us in the vicinity the week before.

As I am eager to know if such a case has ever been referred to you before, will you please drop me a line, as this incident would be one of general interest to shikaris bent on big game hunting, and should be brought to more prominence amongst them. It might incidentally be the saving of some of their skins when out sitting up on machans.

'PEACHLANDS',

SHILLONG, ASSAM.

13th March 1946.

CH. DE LA LONGEREDE,

Hon. Capt., R.I.E., Indian Army.

[There are several instances recorded of tigers climbing trees. In vol. xxxiii, pp. 196-197 of the *Journal* the editors reviewed the literature available on the subject. The maximum height so far recorded is 30 feet; the present instance doubles the known record. The photographs were unfortunately unsuitable for reproduction.—Eds.]

### 2.—A TIGER 'RUNS AMOK'.

An article in the *Calcutta Statesman* of below date reads: 'Man-eater kills 7 coolies, is then killed in battle with wild buffalo.' It then proceeds to give details which appear to me to be inconsistent.

A man-eater is reported to be usually a *sneak thief* and kills for food alone due to some incapacity, old age, and sometimes from inheritance. No wholesale slaughter such as described above

is committed at one time, and that in the presence of an audience presumably in daylight in or near a village and railway station.

Further and fuller and correct details would be very instructive to individuals interested in the study of the psychology of the Carnivora.

From the report as it appears, the tiger is incorrectly described as a *man-eater*, and there is reason to conclude that there is some other phenomenon which has caused this tiger or tigress to 'run amok'.

Your opinion and those of the members would be a valuable contribution.

CORONATION COURT,

4 WEST RANGE, PARK CIRCUS, CALCUTTA.

9th February 1946.

S. A. CHRISTOPHER.

### 3.—A PANTHER WITH TWENTY CLAWS.

On closely examining a panther that I had recently shot I discovered something unique about the claws. On the hind feet it had two extra claws corresponding to the Dew claws in front. Not a malformation, for these claws were fully developed and retractile. I had never met with such an unusual case, nor have my friends, and it must be very rare in feline animals.

It is probably the experience of all big game sportsmen that no two animals are identical, but it would be most interesting to know whether such cases of twenty claws instead of the usual eighteen, are rare enough to be freaks.

I wouldn't say that my panther beats are always productive of interest to naturalists, but even if I shoot another hundred animals, I think I shall find no less interest in my sport than on previous and less exceptional occasions.

LUNAWADA,

14th February 1946.

VIRBHADRASINH,

H.H. Maharana of Lunawada.

[There are at least three records in the *Journal* of panthers having twenty toes. In vol. xxx, p. 909 a photograph appeared illustrating such an abnormality.—Eds.]

### 4.—TIGER KILLS LIONESS.

A tragedy took place recently in the Chamrajendra Zoological Gardens in Mysore City, South India.

Tigers and lions are kept in a large cage in the Zoo, each species in separate compartments. There is an open enclosure with a deep trench all round, and tigers and lions are let out into this enclosure alternately.

Recently a large tiger was let out into the enclosure. The keeper, when cleaning the cage in which the lioness was, admitted her into her adjoining cage without noticing that the door



giving access to the enclosure was open. So the lioness went into the open enclosure into which the tiger had already been admitted.

The tiger at once attacked the lioness. A terrific battle ensued and the lioness put up a brave fight for her life. But she was no match for the tiger and everything the keepers and others could do was futile, so the poor brave lioness was soon killed.

Even a full-grown lion has been known to be no match for a full-grown tiger, the lioness therefore had even less chance, and the poor creature lost her life through the carelessness of a keeper.

MYSORE,

23rd January 1946.

CHARLES THEOBALD, F.Z.S.

### 5.—A QUEER ANIMAL HABIT.

I should be glad to be enlightened as to the purpose, and its reason or cause, to which had been put some small, smooth, cone-shaped rocks which I found in two and far apart caves, while shooting in the N. Chanda Div. before this war, and referred to in my diary as 'wiping stones' (for lack of a better term to suggest the use to which they seemed to have been put by animals, but of whose identity I am still in doubt). Perhaps if I narrate the circumstances in which I found the stones, while describing them, someone might be able to suggest answers to the obvious questions—while an authoritative explanation will be all the more welcomed.

The first cave was shallow and wide open—formed mainly by a projection of the floor to form a narrow ledge outside and which was not completely overhung by the roof, so that the interior was exposed to much of the southern sky; it was situated on the southern face of a rocky spur projecting westward from a low tableland. I had been informed that this cave usually harboured a bear during the hotter part of the day (summer). I never found this cave occupied, nor any visible tracks on the floor, for the surface of the rock that formed it was covered with a thin layer of fine grit. It was during my first visit, while awaiting the return of the occupier (if any) that I noticed a conoid outcrop of rock close to the entrance at one side—because its upper surface was black. I found that it was thinly and fairly evenly smeared—almost glazed—with a black, tarry, substance (but quite dry) which, when I smelt it closely, stank like the faeces of the larger carnivora. Just beside it was a low, smooth, and slightly convex outcrop of rock which bore smudges and smears of the same foul-smelling tarry substance. When questioned, my Gond companion merely muttered 'Reech' (Bear). As our 'lingua franca' was a smattering of Marathi on both sides, I left it at that—though pondering the fact that the excreta of many bears I'd examined in that block consisted mostly of residues of fruits and black ants, also that I had seen the fairly fresh faeces of a panther on the crest above us, while stalking the cave that forenoon. About a fortnight later, while examining the ground near the toe of the spur for signs of the bullet that had smashed the shoulder of a tigress there (which, though badly crippled, had cleared out of that locality), I got a perfect 'sitter' of a shot at a

panther couched on a rock almost directly above the cave (and, as so often with easy 'sitters'—though here tempted by the offer of a thick neck against the sky—missed). A troop of lungoors was always in the jungle below and some usually sat on the toe of the spur before the sun reached it. Of the numerous bears and many solitary boars that roamed the block I saw, here, only one bear, three boars, one porcupine, one civet cat—and, animals unlikely to use caves, sambar, chital and only 2 four-horned antelopes. A pack of jackals found the uneaten carcase of a buffalo on the third night after the tigress had killed it. And the only hyaena I saw was more than a mile from that spot.

The other cave, much larger and deeper, was more than a straight mile away to the south-east, where a nullah cut down through a part of the tableland and found its way out southwardly through sheer cliffs. It was while first reconnoitring the block that I found blurred tracks of a tiger in the gravel of the upper part of the nullah. Losing these tracks where the dry bed was bare rock, the Gond told me that, further down, was a cave which a bear (or bears) occupied during the hot hours of the day (this the month of May and the 'Loo' blowing down the nullah like gusts out of an open furnace). The cave was where the high cliffs began; wide and low of entrance it ran about 40 or 50 feet into the base of a cliff, and two tunnel-like bolt-holes connected with the main passage, from one side. After making strange noises here and then at the mouth of the cave, we gratefully rested just within the entrance and without exploring the dim interior. Almost directly opposite, but high in the other cliff, was another small, oval, cave; the abode of the jungle 'Deo' (god)—for long the legendary protector of the two tigers I knew to be in the block then—and hewn steps led up to it and vermillion paint daubed its arched entrance. Just within the lower cave, and to one side, was another—but more conical—outcrop of rock, having a remarkable resemblance to a phallic stone, smeared with the same stinking, tarry, substance. The light was sufficient to reveal that the floor surface at the entrance had been lightly 'disturbed'—no more than just that; but I could not find footprints nor hairs, nor could I detect odour of animal or human occupation (poachers were usually busy after moonrise and I found two of their 'hides' in the jungle; apparently, caves do not appeal to them, though I often contemplated sitting up in one of these two and refrained only because I was out for tiger and the chance of success was too remote). To my enquiry about the use of that conical stone, my companion again ascribed it to bears—now making a gesture to, and significant movements with, his buttocks. So I wrote in my diary that night, 'Found another wiping-stone there'.

I'd like to mention now that there were a few small, but deep, cliff-caves further down that nullah and which certainly did harbour bears—by which same token I was without sufficient curiosity to enter them. The wounded tigress was finally discovered lying just within the entrance of the large cave and was killed there; she had caught and eaten a porcupine at the first pool (stagnant) lower down the nullah, the night before. My Gond friend, naturally, attributed the satisfactory conclusion of this anxious episode to the

fact that he had previously propitiated the 'deo' in the cave high up in the opposite cliff; but he seemed to maintain that the large cave was used only by bears and clearly did insist that the tigress had *had* to come there to die because she was the protegee, the 'protected', of the 'deo' in the opposite cave! To me an unsatisfactory explanation of the conical stone; for, while measuring and photographing the tigress, I reverted to the subject of that stone. And, from a passing acquaintance with many more caves of that size in India, I had formed an opinion that the larger, more 'open', caves were favoured by tiger and panther, though rather as a 'pied a terre' and on a tacit understanding of 'first come, first served'—bears included; and any small tunnels or burrows within, used regularly by smaller creatures, e.g. porcupines. Indeed, in the southern spurs of the Satpuras I was once shown an almost similar cave and told that, every year, a tigress came there to whelp (probably not the same one annually) and that one was using it then; and, as a matter of interest, I did flush a heavy, sleeping tigress that morning and within a hundred yards of the cave and, as she went lobbing and crashing across my front, I did think she was in cub. But actually, she had been sleeping, heavily gorged, between two of her natural kills.

The stones mentioned still remain a puzzle to me. If used to relieve an irritation caused by worms, surely the attempt would have been made soon after defaecation (as in the case of dogs); and, except for only the droppings of bats in the larger cave, there was none of any kind in either. And while conceding that a bear—because of its all-over shagginess—might be accustomed to thus remove any soiling that had occurred during defaecation, I cannot imagine the larger carnivora having need to do the same, nor that their siesta would be disturbed by such a desire. Yet, that tarry substance stank of the faeces of tiger and panther, with the black of a blood meal—and I cannot understand *how* those protruding (about six and eight inches high, respectively) stones were so evenly smeared over all their upper surface and down to within a few inches of their broad bases (roughly about 8" x 12")!

SINGAPORE,

10th April 1946.

K. BOSWELL,

Capt., I.A.M.C.

[Mr. R. C. Morris to whom Capt. Boswell's interesting note was sent for opinion, comments as follows:—

'Bears do, I think, rub themselves on rocks on defecating after feeding on the pods of *Cassia Fistula* ('Indian Laburnum').

I have observed this on certain rocks in dry river beds: and the local Sholagas gave this explanation.

I have also frequently observed that stones in caves commonly used by bears have a polished appearance; though I have never smelt them. The pods of the *Cassia Fistula* contain, as you know, a thick black tarry substance, which envelopes the seeds, and the Sholagas say that this causes fouling of the hind parts of the bear on defecation; and the animal then resorts to rubbing on rocks.'

This may be the answer to Capt. Boswell's query.—Eds.]

## 6.—'DRAG MARKS' MADE BY THE KYANG (*EQUUS HEMIONUS*).

The Kyang or Tibetan Wild Ass is common and abundant in the neighbourhood of the lakes Mānasarōwar and Rākhas Tāl in Western Tibet. On a recent visit (June-July 1945) I met with it everywhere on the Barkha Plain (ca 15,000 ft. elevation) in troops of 5 or 6, and large herds of over 100 animals. On the bare steppe they frequented I was constantly coming upon curious drag-marks—irregular wavy or meandering lines 2 to 2½ in. wide and 10, 20 or up to 30 yards long, looking exactly like those left by a frisky cow that has a pole or faggot tied to its neck with the loose end trailing on the ground between its forelegs.

There seems no doubt that these marks were produced by the Kyang; exactly how or why is the mystery. The Tibetan yakman explained that they were made by a stallion dragging one of his hoofs along, but could give no reason or say under what circumstances it was done, so all I remarkēd in my diary at the time was 'Why is the ass *such* an ass?'

It would be interesting to know if something has been observed in the habits of the Kyang to suggest the real or probable explanation.

33 PALI HILL, BANDRA,  
BOMBAY, 20.

SALIM ALI.

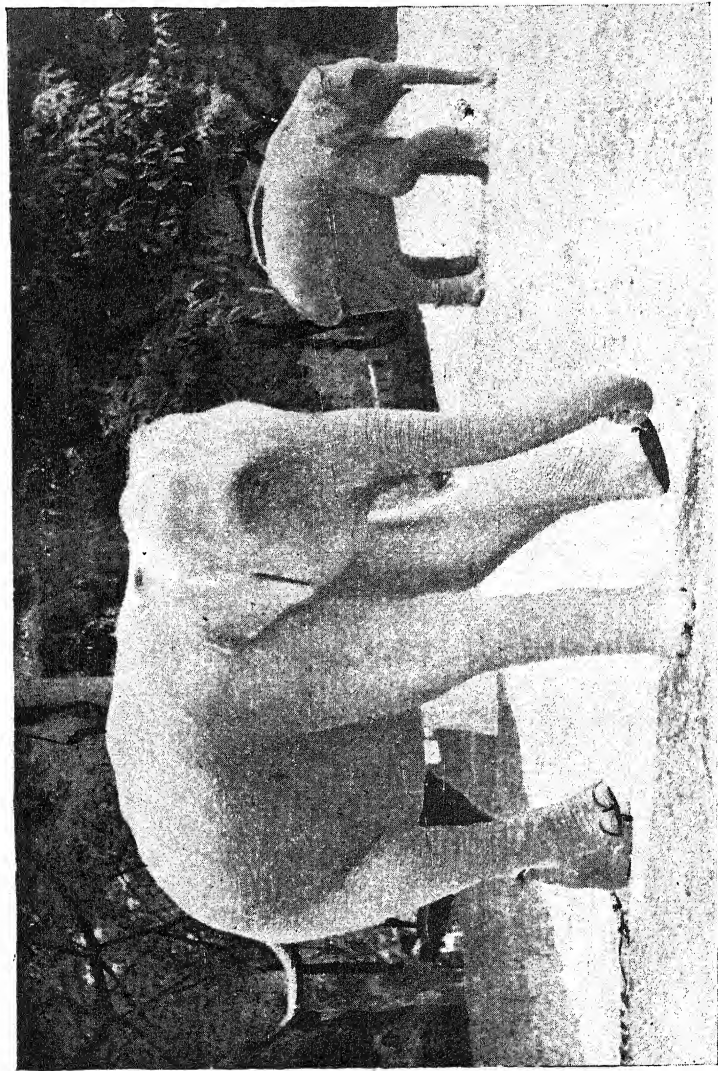
## 7.—AN ALBINO ELEPHANT FROM THE TRAVANCORE FORESTS.

(With a plate)

A cow elephant, captured from the Travancore forests in April 1945, has aroused much interest on account of its colour and other attributes of a white elephant; and it may quite possibly be the first time that an elephant having the characteristics of either partial or complete albinism is observed in India.

This elephant, having a height of 5 ft. 11 in. at the shoulder and whose age is estimated to be 10 years, was caught in a pit at Karippanthode, about 13 miles from Koni, the headquarters of the Central Forest Division. Rao Bahadur T. V. Venkiteswara Iyer, Conservator of Forests, Travancore, examined the animal and finding that it compared favourably with the Siamese White Elephants she has been brought over to the Trivandrum Zoological Gardens for exhibition.

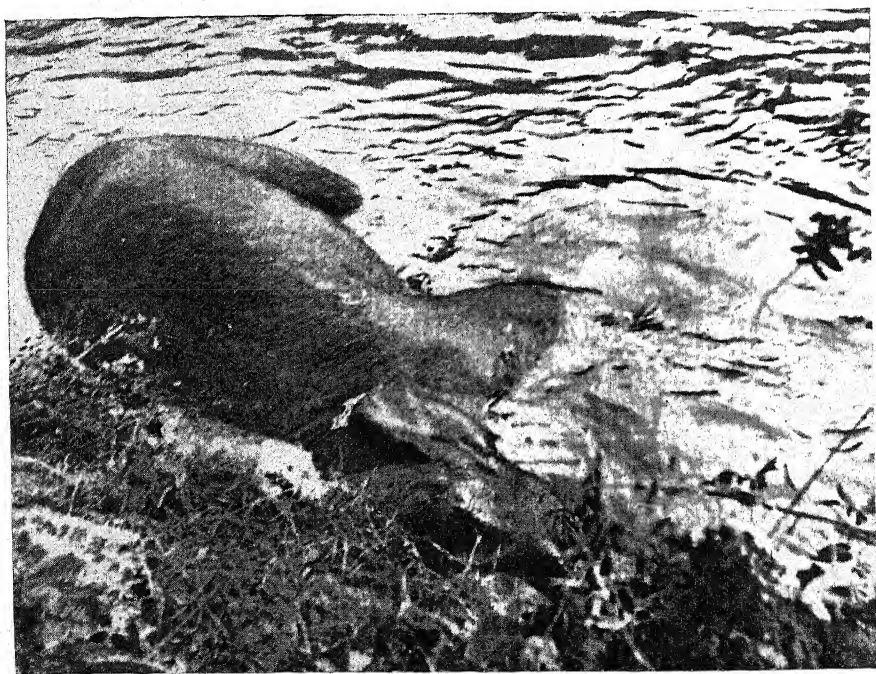
Maheswari, by which name she has since been known, has a light pink skin with white hairs except at the tip of the tail, and pearl eyes. The white hairs on the head are prominent and in spite of them, the light pink background of the skin, gives the elephant a pinkish gray colour. The usual black colour of elephants is nowhere visible on its body. The mouth and palate are also light pink. There are, as usual in ordinary elephants, eighteen toes, four on each forefoot and four on each hind limb, but the toe-nails are



An Albino Indian Elephant from Travancore.



A DYING ELEPHANT. Note the swollen foreleg.



The same animal the next day—DEAD.



of a lighter colour, rather whitish. In all other respects, there is nothing to distinguish it from a normal elephant. She has been under observation for about a year now, and it may be remarked that no change in its colour has taken place during this period.

In a note 'on White Elephants' in the *Journal* (vol. xxvi, 1918, p. 285) Mr. H. Macnaughten refers to a white elephant calf in Burma, which though possessing a light coloured skin at birth had grown perceptibly darker as it grew up. Mr. D. F. Macfie also records (*Journal, Bomb. Nat. Hist. Soc.*, vol. xxxii, 1927, p. 214) the birth of a white elephant calf in N. Siam, and mentions the chief points looked for in white elephants to be light red skin, white hairs on body and tail, very light pink palate, eyes of a light bluish pinky colour and white toe-nails. Evidently, a milk-white colour is not to be expected; the 'whiteness' of an elephant is therefore determined on the possession of the above 'points'. On the basis of this the Travancore specimen has all the attributes of an albino elephant.

Albinism may be observed in any species or any locality and any inference from its distribution may or may not be true. The singularity of the occurrence—though there is only the present solitary instance—of the albino form of *Elephas maximus* on the Malabar Coast, as it has been classically confined to S.E. Asia, may perhaps be significant in affording another instance of faunal affinity between these two regions, a kinship similar to that existing among the Pig-tailed and Lion-tailed macaques, leaf-monkeys, lorises, and civets.

ZOOLOGICAL GARDENS,  
TRIVANDRUM, TRAVANCORE.  
20th March 1946.

E. S. SIMON,  
Curator.

## 8.—NATURAL DEATH OF ELEPHANTS.

(With a plate)

The accompanying plate illustrates two stages, before and after the tragic, natural end of an elephant. The upper of the two photographs appeared in the *Phoenix Magazine* under the title of a *Dying Elephant*, and was submitted by Major P. B. Leahy. The photograph was taken in the Travancore jungles. Mr. F. Connell drew our attention to this fine picture and we tried to get in touch with the author for further details. Owing to the absence of Major Leahy from India, Mrs. Leahy kindly replied and sent us the following details as well as the photos:

'Firstly, I am afraid I have no copy to spare of the photo, but will enclose the negative, and, perhaps you could have it done in Bombay, exactly as you want it for reproduction in your magazine. The other photo I enclosed shows the elephant dead, but, from my point of view as a photographer, and, not a Big Game Hunter it is a bad photo. However you may be interested.

We had heard the elephants making an awful noise in the jungle a few days before this 'subject' was brought to my notice by some coolies. I gathered there had been a fight between two



males, but, it was confirmed when I arrived at the spot where the loser was awaiting death. His leg which was badly swollen made him completely immobile. It can plainly be seen in the photo. If the popular belief about elephants going to the accustomed burial ground be true, there is very good reason why this one couldn't do it as he couldn't walk. However this is not the first elephant to die in the 'Civilisation' of this District. There was another only a few months ago, but, I have no information about that one. It is quite possible that he was also wounded.'

It is a common belief that elephants, and several other animals, anticipate death and accordingly retire to a common 'burial ground', but though certain circumstances suggest this belief, such as the discovery of the remains of several animals in one locality, there is yet no proof forthcoming and must be treated as a popular belief with no foundation. However, it seems possible that a wounded or otherwise weakened animal may retire to a secluded spot in the jungle, or as in the case of elephants, into a river or other marshy ground; they do so not because they anticipate death, but as a means of self-protection. The wounds in the meantime perhaps become septic and the animal is impeded, or the ailment may increase beyond recovery and the animal succumbs to its fate. The point of seclusion may possibly be the only one in the neighbourhood and on this account many animals may consequently retire to the same spot and die. This would undoubtedly result in an accumulation of remains which would naturally give rise to the secular belief of a 'communal grave yard'. But that this is not so is supported by the fact that several animals have been recorded as found dead in the forests.

In the Tropics the agencies of destruction under natural conditions are so rapid and complete that even the carcasses of large animals soon disappear without leaving any traces. It is on this account that dead animals are rarely met with in the jungles.

EDITORS.

#### 9.—A LARGE WILD BOAR (*SUS CRISTATUS*).

In your letter you were good enough to inform me that the average height of male wild boar at the shoulder is 36" and the largest specimen recorded 38½". But in Mr. Burke's statement I find that a wild boar has been recorded up to 40" in height. I give below the measurements of the record wild boar given by Mr. Burke in his *Field Shikar Book* :—

Length 68".

Height at the shoulder and between pegs 40"

Girth at the collar 43½".

Maximum girth 60".

Tushes 10¼".

Tail 12".

What you mention as the record wild boar is smaller than the record given by Mr. Burke. Probably it is due to the fact that the shooter did not send any information to the Natural History Society.

A monster wild boar shot by me last winter is worth recording. So I send you the following measurements, taken in the presence of several reliable gentlemen:—

Length 67".

Height between the pegs 39".

Girth at collar 45".

Maximum girth 61".

Tushes  $7\frac{1}{2}$ ".

Tail  $10\frac{1}{2}$ ".

PHUL-BAGH PALACE,  
MAHISHADAL, MIDNAPORE DIST.,  
BENGAL.

D. P. GARGA,  
*Kumar of Mahishadal.*

29th June 1945.

#### 10.—‘SHAMMING DEATH’.

In an editorial foot-note to the account of a Sambar's death, by Capt. Crawley, in Vol. 45, No. 3, you take exception to the expression ‘Shamming death’. I myself have been subject to the same criticism by Pocock, in his *Mammalia*, with reference to the Hyaena. Mr. William Hornaday, Sc.D., A.M., for years Director of the Zoological Park, New York, and author of a number of books about animals based on years of experience in the field, has, in his well-known book *The Minds and Manners of Wild Animals*, published a picture of an opossum (p. 166) with the caption ‘An Opossum feigning death’.

It is an observed fact, witnessed on hundreds of occasions, that numbers of animals do ‘sham’ or ‘simulate’ or ‘feign’ death.

It seems to me that it is ‘up to’ our critics to supply us with some other term which will adequately describe what takes place and at the same time avoid offence to the hypercritical, as I can think of none which more aptly portrays what takes place. The assumption that the users of these terms are asserting that animals are death conscious and make use of their knowledge cannot in any way be sustained. The terms used accurately and concisely describe exactly what takes place and do not go beyond this: whether the animal's behaviour is conscious or instinctive is entirely another matter.

It is well known that birds will feign injury, to entice a dangerous animal from the vicinity of their young. Is this reasoned or instinctive action?

What is to prevent an animal going a step further, and simulating death itself? Personally, I do not believe that animals are conscious of death. Time to them is infinite, and a dog lying sick unto death, has no realization that he is about to die. Nevertheless to ascribe the simulation of death to instinct alone is unsatisfying. I think it possible, that an animal killed violently, while in full health, may realise, in his last moments, that his dissolution is imminent. When this happens a number of animals give a peculiar cry, quite different from any cry they have ever made hitherto. They make it only once in their lives: immediately preceding death.

It is significant that feigning death is often associated with imminent death by violence.

I have heard this death cry most frequently uttered by boars: this is no doubt due to the fact, that when pigsticking the circumstances of death are such as to induce the cry. I can recall the death cries of stags and horses. The latter is an excruciating sound which haunts one.

How can one explain this death cry? Are we to be satisfied with instinct as an answer? Excessive fear is ruled out by the boar's behaviour at the time.

The main purpose of this letter is to invite readers of the *Journal* to record and publish any observed facts bearing on this most interesting subject, viz. 'Shamming death'.

ELGIN, SCOTLAND.

6th January 1946.

A. A. DUNBAR BRANDER.

## 11.—DISTRIBUTION OF THE RED-CRESTED POCHARD IN SOUTHERN INDIA.

On 9th February 1946 when shooting at Tyravallur lake, about 30 miles from Madras, we got four Red-Crested Pochard (*Netta rufina*), two drakes and two ducks.

When I returned to camp, I looked this species up in the *Fauna of British India* (Stuart Baker) and found that he says that there are hardly any records from southern India, so I thought I would write to you.

On several occasions lately I have seen the Common Pochard (*Nyroca ferina*) on various lakes round here but have not yet taken any. I believe them to be rare in southern India also.

I have preserved two skins of the Red-Crested Pochard and have done soft part studies of them, which I can send if confirmation is required.

I would be obliged if you could let me know what the status of these duck is in southern India. On Tyravallur there were about 200 Red-Crested Pochard which regularly flighted from one end of the lake to the other over some islands, providing ample opportunity for observation.

82 SQUADRON, R.A.F., S.E.A.A.F.

11th February 1946.

H. G. LUMSDEN.

[According to the *Fauna of British India*, the Red-Crested Pochard (*Netta rufina*) becomes rare in southern India. In his recent report on the Survey of Eastern Ghats, Mr. Whistler mentions that Mr. Stoney killed 12 Red-Crested Pochards in the Vizagapatam District in the season of 1928-1929. There are two specimens in the Madras Museum labelled Madras and Arkonam, but that he (Whistler) can find no other record for the Presidency.

The Common Pochard (*Nyroca f. ferina*) is a scarce winter visitor to the Madras Presidency. Mr. Stoney informs us that he shot two in the Vizagapatam District in the same season, 1928-1929.—EDS.]

12.—'BIRDS ON THE HINDUSTAN-TIBET ROAD, N.-W.  
HIMALAYA'—A CORRECTION.

In the list of birds given in the above-mentioned article, which appeared in Vol. 45, No. 4, of the *Journal* of the Society, I regret that by a careless mistake on my part '*Trochalopteron lineatum lineatum* (Vigors): Streaked Laughing-Thrush' was omitted, and remarks relating to that species were erroneously recorded under '*Trochalopteron variegatum variegatum* (Vigors): Eastern Variegated Laughing-Thrush'. The latter was noted only at Thanedar and Bagi, specimens being collected in both of those localities.

RAWALPINDI.

30th April 1946.

H. W. WAITE.

13.—THE PARADISE FLYCATCHER AT SEA.

While on a trip from Bombay to Cochin and still 100 miles north of it and 15 miles from land, I noticed two paradise flycatchers, both cock birds in full plumage (white and black), on the ship's rail. They were first noticed at about mid-day and stayed with the ship till it arrived in Cochin.

I have always been under the impression that these birds live mainly in the north but it is possible owing to the proximity of the Nilgiris that they are to be found as far south. They must have flown from the land to the ship and as they are known not to be long-distance birds, this has caused me considerable surprise and I am writing to inquire whether what I saw was unusual or not. I would be grateful for your comments.

PHOENIX BUILDING,

BALLARD ESTATE,

BOMBAY.

R. SASSOON.

28th March 1946.

[Finding Paradise Flycatchers under the circumstances described is certainly most exceptional. The birds must obviously have been blown out to sea. But there is, of course, nothing unusual in the species occurring as far south as Cochin. In winter it is found in South Travancore, and even Ceylon. Eds.]

14.—SPRING PASSAGE OF PHALAROPES IN IRAQ.

In 1925 Col. R. Meinertzhagen, reviewing the distribution of Phalaropes, (*Ibis*, p. 325), wrote of the Red-necked Phalarope (*Phalaropus lobatus*) 'winters in the north Indian Ocean. . . . May records from Transcaspia and Shiraz, Persia . . . but still on the Mekran coast on 15 and 20 May'. On 23rd May 1943 I saw large flocks totalling eight to eleven hundred near the edge of the flooded Hor el Hammar, four miles west of Shaiba, Iraq. On 6th June two to three hundred were seen. C. B. Ticehurst in 'Birds of Mesopotamia' (*Journ., Bomb. Nat. Hist. Soc.*, 1921, Vol. xxviii, p. 197

*et seq.*) quotes no records other than Zarudny's statement that the species was a winter visitor.

Of *Phalaropus fulicarius* Col. Meinertzhagen wrote 'winter visitor off Mekran coast and south coast of Arabia . . . its passage from Central Asia to Mekran coast takes place in huge bounds with few records of intermediate rest'. On 23rd May I watched one female in full breeding plumage at a distance of twenty feet among the flocks of *P. lobatus*. C. B. Ticehurst knew of no Iraq record. No specimens were shot, but I am familiar with both species, having photographed them in Iceland.

82 A.T. Coy., R.I.A.S.C.,  
BENARES CANTT.  
12th April 1946.

MAJ. P. I. R. MACLAREN.

### 15.—THE WHITE-WINGED WOOD-DUCK

#### *ASACORNIS SCUTULATUS* (Müller)

The following notes on the White-winged Wood-Duck are compiled from observations of a pair which were discovered on the Dhunseri river at Manipur Road (Dimapur), Assam.

The presence of these birds was first brought to my notice by Capt. P. T. French in February 1945. From his description of a pair of duck he had seen flying down the river several times, and



White-winged Wood-Duck

also swimming and feeding in places, I had no hesitation in assuming them to be Wood-Duck.

I was unable to observe them at that time, but on my return from leave in July, I was able to spend two evenings on the river

in the company of Capt. French. He informed me that the duck had not been seen for about 2 months, and only the drake was to be seen, flying down the river every evening. It apparently spent the day some distance upstream, since he had observed it at various points at different times on the river up to 5 miles upstream, from the bridge, and that it was most regular in its habit of reaching the bridge at dusk, about 6.30 p.m.

On the 31st July we took up our position at a point about 100 yards above the bridge. At 6.40 p.m. we heard the drake call as it flew down stream towards us. It came into view about 100 yards away and flew up into a tall tree on the opposite side of the river, about 50 yards distant.

Capt. French stated that its normal practice was to perch in that same tree every evening, watching the bridge until a suitable lull in the traffic, whereupon it would continue its flight. As he had seen it on one occasion at least  $1\frac{1}{2}$  miles further downstream still flying, it appeared to fly a fair distance each day.

We walked upstream, and when we were nearly opposite the tree the drake flew out and upstream uttering a loud goose-like 'honk' of alarm finally perching again in another tall tree overhanging the river about 100 yards away.

We took cover behind some bushes and waited for it to resume its flight downstream; but although it commenced calling again it refused to move, so when it was completely dark we abandoned the scene.

The following evening we took up a new position about 200 yards upstream from the tree in which it had perched the previous evening.

I heard it call once some distance away, then it suddenly appeared almost opposite my hide, flying low over the water. It saw me the instant I raised my gun and giving a honk of alarm swerved away, but a charge of No. 5 brought it down into the river from which it was retrieved a few minutes later. The bird was a fine male and apparently in nuptial plumage. Its crop was full of small black pyramidal seeds of an aquatic plant which abounds in the jheels in Assam.

When the two ducks were observed together earlier in the year, they were in the habit of calling to each other using the low whistle which appears to be the ordinary calling note. When alarmed the note is a loud goose-like 'honk'. It is probable that the drake spends the day on some distant jheel or on the river and visits the nesting duck every night; but as the nest has not yet been discovered this cannot be confirmed. The female, when last seen, closely resembled the male, whose description follows.

Weight,  $6\frac{1}{2}$  lbs.

The bird proved to be good eating though a trifle coarse. The flavour was not marred by either a fishy or muddy taste. It would have been improved considerably by sage and onion stuffing, though this luxury was unfortunately denied us.

604 IND. E. & M. Coy., I.E., S.E.A.C.

T. C. HUTCHINSON,

1st August 1945.

Major, R.E.

## 16.—DO SNAKES DRINK MILK?

While reading *Marvels of Reptile Life* by W. S. Berridge, F.Z.S., I have come across the following interesting passage:—

'All snakes drink very freely, and many of them are very fond of milk. In India, the natives will place saucers full of milk near the hiding places of cobras, or in the temples where they are worshipped, in order to propitiate the reptiles; while the Racer or Whip Snake, to quote the words of Lawson "haunts the Dairies of careless Housewives, and never misses to skim the Milk clear of Cream".'

I have experimented with two cobras and a saw-scaled viper and I can assure you that none of these snakes showed the slightest inclination to take this inviting drink. I have spent some years in places where dangerous snakes, including cobras, are quite common, but I know no instance of any snake having even touched a saucer of milk either offered to it or left by a careless housewife. A learned friend of mine has positively declared that the belief that snakes drink milk is quite erroneous and that milk forms no part of their diet. I may add here that this friend of mine has kept many live snakes.

You know well that Indian snake-charmers play upon the belief of laymen that snakes have a strong liking for milk and these garudiwalas induce the public to pay something to feed their reptile pets on milk. I have more than once offered an attractive tip to snake-charmers if they would feed their snakes on milk before my eyes and I assure you that every time either they have failed or refused to demonstrate on some pretext or another.

May I request you to let me know your views on this interesting subject?

80 A, KURLA ROAD,  
ANDHERI.

20th February 1946.

V. M. VASU,  
Advocate.

[A thirsty snake will readily drink any liquid, be it water or milk, to quench its thirst, but will show no preference for milk. Milk is not a reptilian food.—EDS.]

17.—AESTIVATION OF THE FROG *RAMANELLA*  
*MONTANA* (JERDON).

At Khandala, Western Ghat, on the 20th January 1945 while turning out the debris in a hollow of a tree, I turned out what, at first sight, appeared to be two coleopterous larvae which had been ruptured in the process, but on closer examination they proved to be a pair of frogs, *Ramanella montana*. The hollow was about two feet above the ground and its contents were slightly damp. The behaviour of the frogs at the time of disturbance was certainly curious. The short legs were stiffly, and well tucked into the body and handling did not induce the animals to move them; the body skin was thrown into numerous folds; a strong fold of skin across



the head forming a high ridge close behind the eyes from under which the strikingly small, beady eyes peered out. In this condition the animals looked in all the world as though they were a pair of ruptured larvae of the Rhinoceros beetle (*Oryctes* sp.). In general colouring they were a pale olive grey above and heavily mottled with deep brown and grey below; a brownish, black bordered band crossed the thigh, the middle of the leg, and a third a little way below the 'heel'. When the legs are drawn up the three bands appear confluent; similar bands crossed the forearm and the 'wrist'; a black, broken W-shaped marking was visible at the base of the skull, anterior to this are two black spots and another nearer the snout. The markings appear to be permanent and are still visible in preservation.

On dissection the two proved to be male and female. Except for size, and some paler patches behind the head and about the loins in the male, there did not appear any marked external differences between the sexes. The female measured 45 mm. from snout to vent, and the male 33 mm. An examination of the gonads indicated that the ovaries were slightly enlarged and the ova distinctly granular. The fat bodies were much enlarged and filled the greater part of the abdominal cavity. The testes of the male were still small, and like the female, the fat bodies were enlarged and occupied a considerable portion of the body cavity.

Be it coincidence or otherwise, this was the first time I found a pair, male and female, of this frog aestivating together. It is well-known that some other species of frogs collect and aestivate together in the same cavity.

BOMBAY NATURAL HISTORY SOCIETY,

BOMBAY,

C. McCANN.

20th March 1946.

#### 18.—THE DISTRIBUTION OF *RANA LEITHII* BOULENGER.

Judging from the fact that *R. leithii* was represented by a single specimen, the type, in the British Museum, Natural History, up to the time it was 'rediscovered' by me at Khandala (vide *Journ., B.N.H.S.*, xxxvi, p. 167) it would appear to be a rare species, but since then I have been able to record it from various other localities in the Bombay Presidency, viz. Gersoppa Falls, N. Kanara; Kanari Caves, Salsette Island; Lingmala Falls, near Mahableshwar; and recently I collected it at Matheran, the type locality.

In most of the above-mentioned localities the frogs were frequent, but at Matheran they were definitely *very common* at dusk after the thunder showers on the 10th and 11th June (1945). There were actually hundreds hopping about the roads, among the rocks of the boundary walls and among the fallen leaves. When I mentioned to my companion Mr. Manek Captain that the frogs appeared to me to be the 'rare' *R. leithii* he rightly had the laugh of me,

for *R. leithii* it was, and it was there in its hundreds, and so I must now substitute the word *common* for the word *rare*.

The Matheran specimens were in breeding condition.

BOMBAY NATURAL HISTORY SOCIETY,

BOMBAY,

C. McCANN.

14th June 1945.

#### 19.—STRONG ODOUR EMITTED BY THE FUNGOID FROG (*RANA MALABARICA*).

In my articles on *Reptilia* and *Amphibia* I referred to *Rana malabarica* as the Fungoid Frog on account of the close resemblance of its colouring to one of the bark or wood attacking fungi. At the time when I gave it this name, I was not aware of its ability to enhance the camouflage by emitting a powerful fungoid odour. In most cases I had dealt with it in the open. When on a short visit to the Tansa Lake I found one of this species inhabiting the bathroom of the bungalow. I closed the doors of the room and tried to catch it. As soon as I chased it about I became aware of a strong fungus-like odour in the room: for a while I could not account for the smell. When I caught the animal the odour became stronger than ever, and so I immediately suspected the frog as the author of the scent. When I put it to my nose for confirmation, there remained no doubt. To make sure I asked my companions to verify my observations, they agreed that the frog did give out a strong smell.

The dorsal surface of *R. malabarica* is highly glandular; in this respect it is not the only species, and it will be interesting to know whether the other species are also capable of emitting an odour. In *R. malabarica* there appears to be little doubt that the odour coupled with its colouring and habits afford it protection from many a would-be enemy.

BOMBAY NATURAL HISTORY SOCIETY,

BOMBAY,

C. McCANN.

20th May 1946.

#### 20.—A RECORD MAHSEER.

(With a plate)

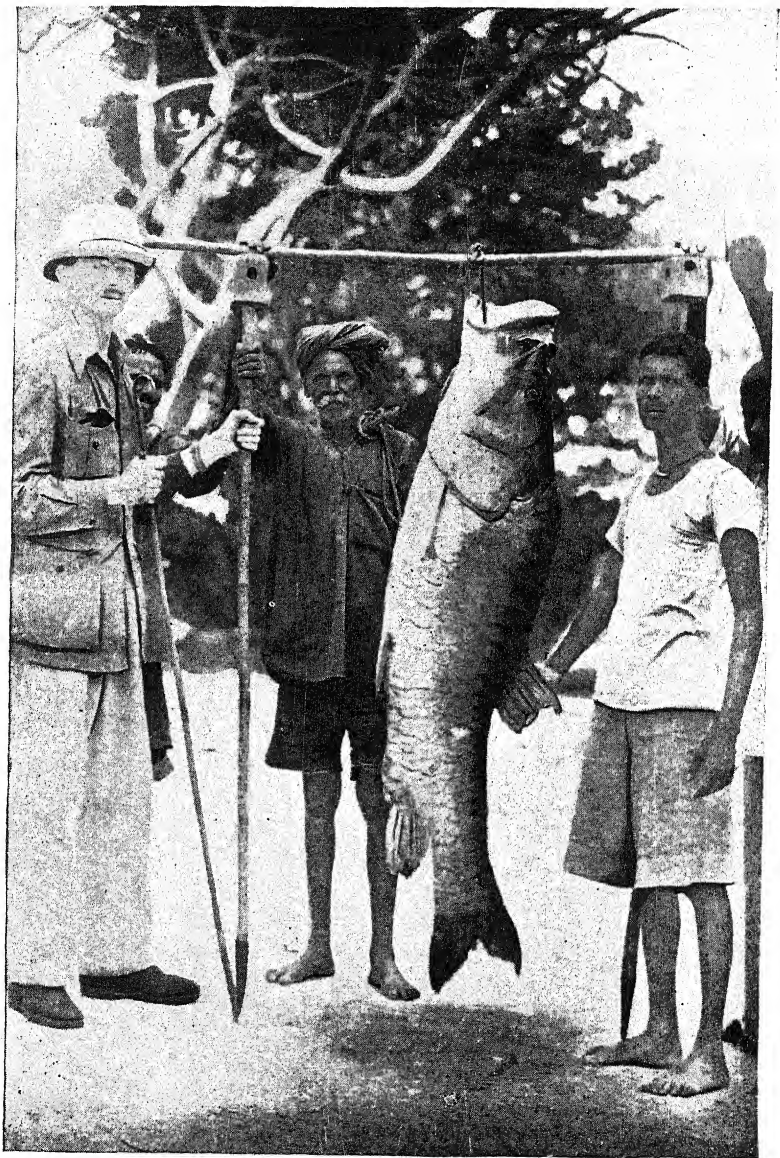
I enclose a photograph of a Mahseer I caught in the upper regions of the Cubban River on 22-3-1946:—

Weight: 120 pounds.

Length: 66½ inches.

Girth: 41½ inches.

Mouth diameter: 10 inches.



A Record Mahseer (*Barbus tor*) from the Cubbany River, Mysore. 120 lbs.



The previous record was held by Colonel Rivett Carnac, caught in 1919:—

Weight: 119 pounds.

Length: 64 inches.

Girth: 42 inches.

The photograph was taken nearly 24 hours after the fish was caught.

As this is the record Mahseer, its publication will be of interest.

'BISSAL MUNTI',

MYSORE,

11th April 1946.

J. DEWET VAN INGEN.

## 21.—ON THE BIONOMICS OF THE INDIAN SPRAT

[*SARDINELLA GIBBOSA* (CUV. & VAL.).]<sup>1</sup>

The Indian Sprat, *Sardinella gibbosa* (Cuv. & Val.) is a shoaling fish is of economic importance. It occurs in the Palk Bay and the northern portion of the Gulf of Manaar, throughout the year.<sup>2</sup> It is captured by means of shore seine nets, cast-nets and drift nets, and is chiefly sun-dried for export to the districts of Madura and Trichinopoly, and to Ceylon.

*Size*.—About one thousand specimens ranging in size from 5 to 16 cm. were examined. The commercial catches consist mainly of fish measuring 13 to 15 cm. long, but in April and May, large numbers of young sprats, 5 to 10 cm. in length, are attracted by night by torch-flares, into shallow waters, and baled into the canoes with hand nets. This indiscriminate fishing, irrespective of size, may have an adverse effect on the future fisheries. Sexual maturity is attained when the fish reaches a length of 14 cm.

*Food*.—The diet of the fish consists of plankton. The following organisms have been found in its stomach:—

*Zooplankton*.—Foraminifers, *Sagitta* spp., larval bivalves, *Creseis acicula*, *Spiratella* spp., *Nauplius* larvae, *Zoea* larvae, *Megalopa* larvae, copepods, *Leucifer hansenii*, *Rhopalophthalmus egregius*, and fish-larvae.

*Phytoplankton*.—*Coscinodiscus*, *Detonula*, *Fragilaria*, *Rhizosolenia*, *Thalassiothrix* and *Trichodesmium*.

Crustacean larvae, Pteropods and *Trichodesmium* form the chief food of this fish. Its fishery will, therefore, fluctuate in accordance with the paucity or profusion of the plankton. This fish is also one of the few which feed on the arrow-worms, *Sagitta* spp. The presence of foraminiferan shells in the stomach of specimens

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<sup>1</sup> Part of work done by the author at the Krusadai Biological Station, Gulf of Manaar. Published with the permission of the Director of Industries and Commerce, Madras.

<sup>2</sup> Specimens of *Sardinella brachysoma* (Bleeker) and *S. sindensis*, Day, are also represented in the shoals in small numbers.

examined on certain days suggests that the fish fed on some foraminiferan ooze. Fish-larvae were never numerous, though they were frequently found in isolated specimens.

*Spawning season.*—The Indian Sprat has a single but prolonged spawning period, from September to February. Specimens with fully transparent eggs were obtained in December and January. Specimens partly or fully spent were seen in January and February.

*Eggs.*—The ripe ova measure 0.56 to 0.60 mm. in diameter. Eggs obtained from the plankton measured 0.58 to 0.64 mm. in diameter. No attempt has been made to investigate the embryonic and larval development.

*Enemies.*—Specimens of the Indian Sprat have been recorded in the stomach-contents of the following fishes:—*Chirocentrus dorab* (Forsk.); *Otolithus ruber* (Bl. Schn.); *Lactarius lactarius*, Cuv. & Val.; and *Sphyræna obtusata*, Cuv. & Val.

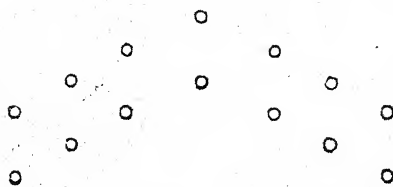
FISHERIES BRANCH,

DEPARTMENT OF INDUSTRIES AND COMMERCE,  
MADRAS.

P. I. CHACKO.

## 22.—MOVEMENT OF A GROUP OF INSECTS IN INDIA.

Near the town of Vyara, in the State of Baroda, Surat District, India, one day I noticed a small group of insects moving across the verandah floor. They seemed to be travelling in formation. At almost regular intervals all stopped and started simultaneously. There were approximately fourteen in the group and were arranged somewhat as follows:—



I judge the distance they covered between each start and stop was approximately one inch and the stops were of about one second duration. By observation no detection of a leader could be made for all seemed to start and stop simultaneously.

This kind of motion continued across the verandah, a distance of about six feet until an ant came into the formation. This confused them temporarily and they drew off into two divisions, but as the ant moved on they gradually came back together regaining their former rhythm and almost the same formation.

The insect was small in size, approximately that of a *Drosophila*, or a bit larger. Its shape was somewhat that of a grasshopper. In colour it was light grey or brown.

The above data is given from memory after an interval of five or six years but I think it is essentially accurate. The formation and motion of the group was so unique that it is difficult to forget.

EARL M. ZIGLER,  
Missionary.

[The above note was sent to us by Dr. C. B. Williams, Head of the Department of Entomology, Rothamstead Experimental Station, Harpenden, Herts, for publication in the hope that some reader may be able to solve the problem and obtain specimens.—Eds.]

### 23.—A 'HERMIT' SPIDER.

About the middle of November last, I bought a number of botanical specimens from the Victoria Gardens. One specimen of *Memycelon edule* (*Melastomaceae*) had an open cocoon of a moth suspended from the branch and in it was lodged a beautiful yellow coloured striped spider which has been identified by the Zoological Survey of India as a female of a *Olios* sp. (The species could not be identified as the specimen was immature.) This to my mind is the first record of a spider inhabiting the cocoon of a moth, and so I hasten to record it in your *Journal*.

WILSON COLLEGE,  
BOMBAY,  
11th April 1946.

MOSES EZEKIEL.

[Spiders will often occupy any convenient cavity either as a retreat or, as a 'safe deposit' for their egg-cases. We have known them to occupy the 'bore holes' made by beetle larvae, Humble-bees (*Xylocopa*), and also the deserted cells left in the mud nests of mason wasps.—Eds.]

### 24.—ABNORMAL FLOWERING OF *CAREYA ARBOREA* ROXB. IN KHANDALA.

*Careya arborea* Roxb. is a very common tree about Khandala. Under normal circumstances, when the tree is in leaf, it is very conspicuous on account of the large size of its leaves; during the flowering and fruiting season, the size of the flowers and the disagreeable smell of the fruits cannot fail to draw the attention of even the least observant of botanists.

New leaves begin to come out at the beginning of the rainy season, when most of the over-ripe and evil-smelling fruits fall from the tree. The leaves are large and of a bright green colour, until the approach of the flowering season. Towards the end of February leaves slowly turn from green into various shades of brick red, and then gradually fall off, until there remains but the bare skeleton of the tree. Buds appear shortly after leaf-fall, some time in the middle



of March; flowers may be seen from the second half of March onwards up to May.

On January 24, 1942, Mr. C. McCann and myself noticed a tree on Behram's Plateau near Khandala which showed very marked irregularity in its flowering rhythm. One branch, about one-third of the tree, was in full bloom and without a single leaf on; the rest of the tree was still fully clothed with all its leaves and did not show any signs of approaching flowering. On further examination we found that a large fire had been lit just beneath the branch in question, and that in consequence of the fire all the leaves had either been burnt or scorched; there resulted a general leaf-fall for that particular branch, the scorched or half-burnt leaves still covering the ground beneath the scorched branch. This particular branch was at the time loaded with flowers and buds, exactly like any other branch at the proper flowering time at the end of March.

The rest of the tree, which had not been affected by fire, only came into flower at the end of March of the same year; by which time the abnormal branch had *normal ripe fruits*.

Two explanations occur which may explain this abnormal behaviour of *Careya*. Possibly flowering and fruiting is induced by defoliation; or perhaps a considerable rise in temperature even for a short time may be responsible for the sudden flowering of the tree. These two points are easy enough to test experimentally, and may be taken up in the case of *Careya* and similar deciduous trees; I leave it to experimental plant physiologists to settle such an interesting subject, from the solution of which we may expect to get an insight into the agencies controlling the strange behaviour of some of our Indian deciduous trees.

ST. XAVIER'S COLLEGE,  
BOMBAY,  
12th March 1946.

H. SANTAPAU, S.J.

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